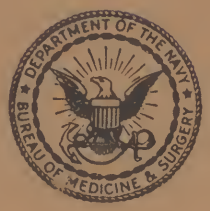
EPIDEMIOLOGY OF DISEASES OF NAVAL IMPORTANCE IN FORMOSA



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PREFACE TO SECOND PRINTING

Although some additional information has become available since first publication of this manual, it is not of sufficient importance to change the basic picture significantly. Since the need for an additional printing of this publication has become pressing, it is reprinted at this time without an attempt at revision.

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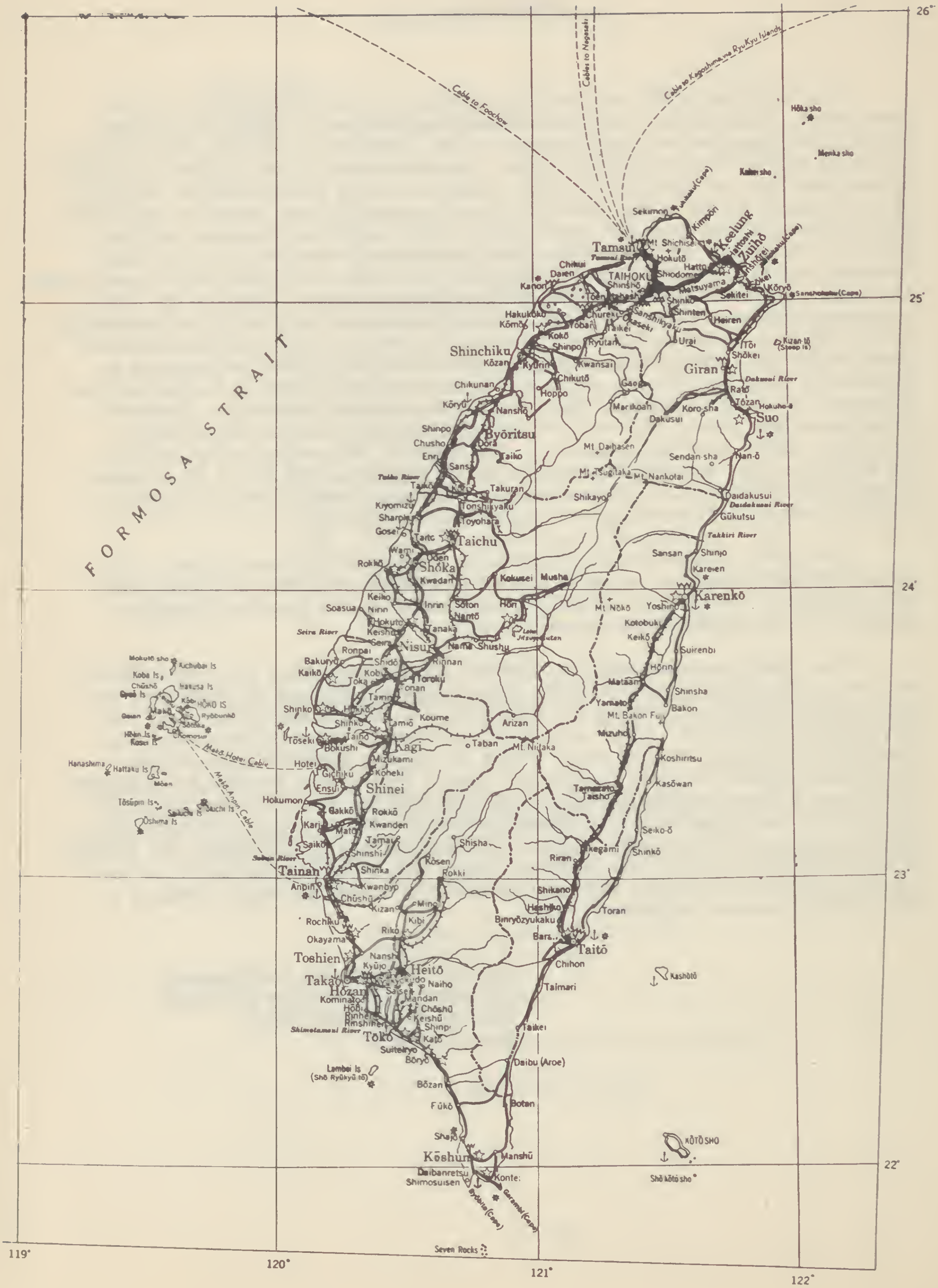
FOREWORD

The purpose of this manual is to present a condensed picture of the prevalence, distribution, and epidemiology of diseases of Naval importance in Formosa together with information on the distribution, habits, and identification of vectors and reservoir hosts. Because some of the important sources of material are not available in this country or were unavailable for various other reasons, some of the material is not as complete as would be desirable. This is particularly true for some of the acute infectious diseases and the venereal diseases. Emphasis has been placed on the epidemiology of those diseases which present a picture different from that which has been experienced elsewhere by Naval medical and H-V(S) officers. Hence, although the acute respiratory diseases are the most important cause of morbidity and mortality, more attention is devoted to the arthropod-borne diseases and helminthiases because the latter will present more novel situations to our personnel. An apparently disproportionate amount of space has been given to tsutsugamushi disease in view of the small number of cases reported annually. However, experience has already shown that this disease may become exceedingly important under combat conditions. Considering this and also the fact that its epidemiology, both on the main island of Formosa and in the Pescadores Islands, differs from the epidemiology of tsutsugamushi disease elsewhere, a more elaborate discussion was thought to be desirable.

The area included in this manual is primarily the main island of Formosa although material on the Pescadores Islands has been included whenever available. Reference is made occasionally to the Loochoo (Ryukyu) Islands for comparative purposes.

The principal sources of statistical information have been the official reports in the Statistical Yearbook of the Japanese Empire (in Japanese) and the Taiwan Sotokufu Tokeisho (in Japanese), the Statistical Reports of the Formosa Government. Other important sources of information have been the Taiwan Igakkai Zassi (Journal of the Formosan Medical Association); the entomological journals Kontyo, The Insect World, and Tenthredo; Kitasato Archives of Experimental Medicine; Gunidan Zassi, the official publication of the Imperial Japanese Army Medical Corps; Transactions of the Natural History Society of Formosa; Kaigun Iji Hokoku Satsuyō Kaigunsho, the reports of the Medical Bureau of the Japanese Navy; and Dobutsogaku Zassi; as well as other Japanese journals and monographs. The bibliography contains a list of the principal references used.

Bureau of Medicine and Surgery
Division of Preventive Medicine
Section of Epidemiology
June 10, 1944



FORMOSA STRAIT
Cable to Foochow
Cables to Nagasaki
Cable to Kagoshima via Ryukyu Islands
Hōka sho
Menka sho
Kahen sho
Sekimon
Kimpōri
Keelung
Zuihō
Tamsui
Mt. Shichisei
Hokutō
TAIHOKU
Shinshō
Shiodome
Hatto
Matsuyama
Chikuui
Daren
Kanon
Tōen
Shinkō
Shinten
Sekitei
Kōryō
Heiren
Hakukōkō
Kōmō
Churek
Taikei
Yōbai
Urai
Kokō
Shinpo
Ryutan
Kwansai
Shinchiku
Kōzan
Kyūrin
Chikutō
Hoppo
Kizan-tō (Steep Is)
Tōi
Shōkei
Giran
Dakusui River
Ratō
Tōzan
Chikunan
Kōryū
Nanshō
Gaogo
Marikoah
Dakusui
Koro-sha
Suo
Shinpo
Chusho
Enri
Byōritsu
Dōra
Taiko
Sansa
Mt. Daibasen
Sendan-sha
Nan-ō
Taikō River
Taikō
Takuran
Mt. Tsugitaka
Mt. Nankotai
Shikayō
Daidakusui
Daidakusui River
Kiyomizu
Tonshikyaku
Toyohara
Shampo
Gūkutsu
Gosei
Taitc
Taichu
Takkiri River
Wami
Sansan
Shinjo
Rokkō
Tōen
Shōka
Kareien
Kwadan
Kokusei
Musha
Keikō
Ninin
Inrin
Sōton
Hōri
Mt. Nōkō
Yoshino
Karenkō
Soasua
Nantō
Hokuto
Keishō
Tanaka
Kotobuki
Seira River
Keikō
Seira
Nisui
Nama
Shushu
Ronpai
Shidō
Rinnan
Suirenbi
Bakuryō
Kaikō
Kobi
Tōroku
Tōka
Tōnan
Hōrin
Mataan
Shinsha
Tarimu
Shinkō
Hokkō
Kourne
Yamato
Bakon
Mt. Bakon Fu
Shinko
Taihō
Lamiō
Arizan
Mizuho
Tōseki
Bokushi
Kagi
Taban
Mt. Niitaka
Hotei
Mizukami
Koshiritsu
Gichiku
Kōheki
Ensui
Shinei
Kasōwan
Hokumon
Tamazato
Taishō
Gakkō
Rokkō
Kwanden
Kari
Matō
Tamai
Seiko-ō
Saikō
Shinshi
Shisha
Riran
Ikegami
Shinkō
Sobun River
Tainan
Shinka
Kōsen
Rokki
Anpin
Kwanbyo
Chūshū
Shikano
Kizan
Mino
Toran
Hashiko
Rochiku
Kibi
Binryōzyukaku
Okayama
Riko
Bara
Taitō
Toshien
Nansh
Kyūjo
Heitō
Chihon
Takao
Naiho
Kashōtō
Hōzan
Saisei
Mandan
Kominato
Talmari
Hōbi
Chōshū
Rinhei
Keishū
Rinshihen
Shinpi
Shimotamsui River
Tōkō
Taikei
Katō
Suiteiryo
Bōryō
Daibu (Aroe)
Lambei Is
(Shō Ryūkyū tō)
Bōzan
Botan
Fūkō
Shajō
KŌTŌ SHO
Kōshun
Manshū
Daibanretsu
Shimosuisen
Konte
Shō kōtō sho
Byōbita (Cape)
Garanbi (Cape)
Seven Rocks
Mokutō sho
Kichibai Is
Koba Is
Chūshō
Hakusa Is
Gyoō Is
HŌKO IS
Makō
Ryōbunkō
Gosan
Hiyan Is
Kosei Is
Chomosui
Makō Hotei Cable
Makō Anpin Cable
Hanashima
Hattaku Is
Tōsupin Is
Oshima Is
Sanchi Is
26°
25°
24°
23°
22°
119°
120°
121°
122°

CHAPTER I

INTRODUCTION

Formosa is a large continental island which is separated from the east coast of China by the Taiwan Strait, the width of which varies from ninety to two hundred miles. In the southern part of the Taiwan Strait lie the Pescadores (Bōko) Islands, sixty-four in number. To the north and east of Formosa lies the Ryukyu (Loochoo) Archipelago which extends to the southeastern tip of Kyushu, the southernmost island of Japan proper. Latitudinally Formosa is bisected by the Tropic of Cancer. It is in the form of an elongated oval with northeast-southwest axis about 225 miles. The breadth varies from 60 to 80 miles. The area of Formosa is about 14,000 square miles. The island can be divided into three parts, the broad western slope with its alluvial plains, the mountains proper, and the narrow eastern slope terminating in a high and precipitous coast. In addition to the main island and the Pescadores (Bōko) group, Formosa proper also includes fourteen small islands lying at various distances from the coast.

Formosa presents a variety of climates, frigid, temperate, subtropical, and tropical depending on altitude and exposure. However, in general, the climate is tropical and is influenced by warm ocean currents.

On the plain the temperature falls below 15°C. only in January. In Taihoku the average maximum temperature is 36.2°C. and the average minimum temperature is 4.8°C. The absolute maximum is 38.6°C. and the absolute minimum is 0.2°C. In Taitō the average maximum temperature is 35.4°C. and the average minimum temperature is 10.4°C. The absolute maximum is 39.0°C. and the absolute minimum is 7.4°C.

The rainfall of Formosa is high and well distributed throughout the year although the southern part is relatively dry in winter. The annual rainfall is 2,123 mm. in Taihoku, 1,785 mm. in Taitō, 1,517 mm. in Sinchiku, 1,774 mm. in Taichu, 1,730 mm. in Tainan, 1,607 mm. in Takao, 1,925 mm. in Karenko, 6,665 mm. in Kashoryo (near Kiirun) and 993 mm. in Bōko.

The dry and rainy seasons in the north occur at precisely the opposite time of the year at which they occur in the southern part of the island. In the north due to the seasonal northeast wind, the rainy season is fairly cold and lasts from October to March. The rainy season in the south (April to September) is characterized by frequent heavy tropical rains.

The population of Formosa is predominately Formosan Chinese with the Japanese and aborigines constituting the minorities. This is illustrated by the following table:

TABLE I

Population Groups in Formosa

Year	Formosan Chinese	Japanese	Aborigines
1922	3,614,207	187,953	83,164
1931	4,426,122	243,872	88,698
1938	5,392,806	308,814	156,017

The Chinese are mainly derived from Fukien and Kwangtung Provinces and are particularly predominant in the coastal plain. The aborigines are divided into subdued aborigines and wild aborigines. The latter constitute a serious problem for the Japanese and are enclosed by an electrified guard-line of over 300 miles.

For administrative purposes the island has been divided since 1920 into five prefectures and three districts. In the heavily populated western part of the island there are five prefectures: Taihoku, Shinchiku, Tainan, Takao, and Taichu. The eastern part, which is sparsely populated, consists of two districts, Taitō and Karenko. The Bōko Islands (Pescadores) comprise a third district. The area, population and population densities are given in the following table:

TABLE II

Area, Population and Population Density of Formosa Arranged by Prefecture and District

Prefecture and District	Area in square miles	Population	Number of people per square mile
Total	13,886	4,932,433	355
Taihoku	1,762	998,103	566
Shinchiku	1,775	709,478	400
Taichu	2,850	1,096,925	385
Tainan	2,092	1,241,597	593
Takao	2,208	673,267	305
Taitō	1,361	62,685	46
Karenko	1,786	95,366	53
Bōko	49	65,012	1,327

Since 1920, the health administration of Formosa has followed closely that of Japan. The Sanitary Bureau of the Government-General of Formosa is in charge of the health administration of the whole territory. In the

prefectures the health affairs are undertaken by the Sanitary Division of the Bureau of Police while in the districts by the police physicians. The Central Research Institute, the Research Bureau of Tropical Medicine and the Taihoku Medical College have done a great deal of research and investigation.

Medical care is undertaken at the hospitals and clinics. The following table shows the number of hospitals, physicians, etc., in the years of 1932 and 1937.

TABLE III

Medical Personnel and Facilities in Formosa

Medical Personnel and Facilities	1932	1937
General practitioners	305	*
Other physicians	1,403	1,834
Dentists	263	402
Pharmacists	123	190
Midwives	1,524	1,744
Government Hospitals	14	15
Public Hospitals	18	18
Private Hospitals	164	221
Druggists	2,649	3,335
Pharmaceutical manufacturers	20	29

*Data not available

The prefectural distribution of the hospitals, physicians, and other medical personnel in 1932 is shown in Appendix A.

CHAPTER II

MALARIA

Malaria is one of the most important causes of morbidity and mortality in Formosa. As a cause of death it takes an inferior rank only to tuberculosis, the acute respiratory infections, and the acute enteric diseases. In 1915 there were more than 13,000 deaths recorded as due to malaria. Since that time this number has been reduced considerably so that in 1932 only 3,335 malaria deaths were recorded. This is 3.4 percent of all deaths due to disease. In 1935 it was estimated that 85 percent of the malaria cases were from the eastern and western coasts and in the southern half of the island. The mountainous areas as well as such large cities as Taihoku, Taichu, and Tainan are virtually free of malaria. According to the reports in the Statistical Yearbook of the Japanese Empire, malaria occurs in all of the prefectures and districts although the situation in the Bōko (Pescadores Islands) is not clear. The available reports from recent years do not list cases of malaria from these islands and the only species of anopheline mosquito reported by Morishita (1936) is the brackish water species, Anopheles indefinitus, which is not generally regarded as a malaria vector. Mittsunaga, Kasugawa, and Uchida (1916) listed in the reports of the Medical Bureau of the Japanese Navy Department 5,948 cases of malaria and 61 deaths due to malaria for the years 1908-1913 inclusively. The data from the Statistical Yearbook of the Japanese Empire also indicate that malaria occurs during every month of the year.

Further emphasis concerning the importance of malaria in Formosa comes from the statistical studies of Nisimura (1931). The following table is taken from the data compiled by this author.

TABLE IV

Malaria Cases in Government and Public Hospitals

Year	Number of Malaria Cases	Percent of all Admissions
1897	47,342	21.7
1902	31,039	22.8
1907	49,129	21.6
1912	45,975	22.2
1917	81,739	28.0
1922	73,569	16.9
1927	78,960	12.4
1930	65,481	10.3
*1932	83,932	

*Added from Statistical Reports of Formosan Government. This figure includes outpatients.

Nisimura (1931) cites the results of examinations of 2,271,679 persons for plasmodia at 145 localities in 1930. Of these 34,182 (1.5 percent) were found to be positive. This represents a considerable decrease from the results of the investigations of 1915-1925 when rates of two to three percent were observed.

Although vivax-, malariae-, and falciparum-malaria are all known to occur in Formosa, it is commonly stated that vivax infections are the most common. As in other areas malariae infections are sporadic. Hatori (1925) examined 23,000 school children in Taihoku and found vivax, falciparum, and malariae in the ratio of 72:68:10. Mitakayeshi (1927) in eastern Formosa, however, found that 68 percent of the cases were falciparum infections, 22 percent were vivax, and 7 percent malariae; the remainder were mixed. Among 816 cases observed by Akashi and Yoshimura (1937) 54 percent were vivax infections, 42 percent were falciparum, and 1 percent were malariae.

Because the anopheline vectors are widely distributed and because large numbers of human reservoirs are present, malaria must be regarded as a most important disease from the standpoint of operations.

THE MALARIA VECTORS

According to the latest available paper by Morishita (1936) there are at least fourteen species and subspecies of anopheline mosquitoes in Formosa. Eight of these are known or suspected to be vectors of malaria. Information concerning the systematics and distribution of Formosan anophelines is drawn principally from the papers of Koidzumi (1926, 1927, 1927); Koidzumi and Morishita (1932); and Morishita (1932, 1932, 1936, 1936, 1936, 1936). Material on the feeding habits of the various species is derived largely from the studies of Morishita and Katakai (1933) whereas the information on natural and artificial infection is that derived from the studies of Anazawa (1926, 1926, 1928, 1931).

This section is devoted primarily to the available information concerning the relation of Formosan anophelines to the epidemiology of malaria and to such information as may be of value in planning and executing control measures. Material pertinent to nomenclature identification, taxonomy, and detailed distribution is assembled in Appendix B.

1. Anopheles hyrcanus sinensis. This subspecies is typically a swamp and rice field breeder although the larvae are also found in drainage ditches, puddles, lakes, burrows, drains, grassy pools, etc. Usually the larvae are found in open water although sometimes in shady places. It is generally a clean water species. It is commonly a fresh water form although it has been known to breed in brackish water in India. Anopheles hyrcanus sinensis is essentially a wild mosquito and breeds independently of the proximity of habitations. It is characteristically, although not necessarily, a mosquito of open country because of its close association with rice fields. It does not usually occur at higher altitudes because of the absence of rice fields. It feeds on both humans and animals not only at night but also sometimes during daytime. Using precipitin tests Morishita and Katakai (1933) found that only two percent of the females feed on human blood and that the principal hosts are water buffaloes and cattle. Adult females are frequently found in stables after having sucked blood. The role of sinensis in the transmission

of malaria varies considerably from area to area. Anazawa (1931) has found a natural infection index, 0.8 percent in Formosa. His experimental data show an experimental infection index of 60 percent with vivax, 17 percent with malariae and no infection with falciparum. Anopheles hyrcanus sinensis should be regarded as an important vector in Formosa. According to Koidzumi (1927) and Morishita (1936) it is the most common mosquito in Formosa.

2. Anopheles minimus. This species is especially a breeder of slowly running streams with grassy edges, edges of swamps, seepages from springs, burrow pits, and rice fields. The typical breeding water is fresh, clear, relatively cool, standing or flowing, sunlit or shaded. Larvae are not found in foul water, brackish water, or in rapid currents. In rice fields the larvae are generally found only where there is fresh cool water. In the Philippines minimus flavirostris is typically a brook breeder and it is possible that the same may be true in Formosa. Anopheles minimus is usually regarded as a species of the low and moderate altitudes. It is moderately anthropophilic in areas with livestock and much more anthropophilic in areas where there are few livestock. Morishita and Katakai (1933) found that about 20 percent of the females obtain meals of human blood. In general Anopheles minimus is an important vector throughout its range. In Formosa Anazawa (1931) stated that 2.4 percent of the females were infected. Experimentally (1931) he was able to get infections of 65 percent with vivax, 12 percent with malariae, and 64 percent with falciparum. Morishita (1936) states that it is found throughout the entire island and according to Koidzumi (1927) it is, next to sinensis, the most numerous species.

3. Anopheles maculatus. The breeding habitats of this mosquito are essentially streams and river beds; it has been found breeding much less frequently in pools, lake margins, rice fields, drains, and occasionally in artificial receptacles. The breeding waters are usually clear, well-oxygenated, and exposed to sunlight. Frequently malaria has become endemic in upland areas as the result of removing the shade from the streams thereby making breeding habitats for Anopheles maculatus. This species may occur at altitudes as high as 3,000 feet, although it may not be found at these altitudes in Formosa. Little has been published concerning its breeding habits in Formosa although in Malaya and the Netherlands Indies it is known to be strongly anthropophilic. In Formosa Anazawa (1931) has observed it to be anthropophilic. It is more frequently captured in traps than in dwellings. Natural infections of 0.4 percent have been recorded in Formosa by Anazawa (1931). The same author (1931) obtained experimental infections of 63 percent with vivax, 32 percent with malariae, and 48 percent with falciparum in Anopheles maculatus. According to Morishita (1936) it occurs throughout the island. Koidzumi (1927) states that it is most numerous in the foothills and in the mountains. It is the third most common species although it is rare in the northern part of the island. It should be regarded as a vector in Formosa, especially at higher altitudes.

4. Anopheles maculipalpis splendidus. This form is frequently regarded as a distinct species, Anopheles splendidus. Its larvae usually occur in small pools along mountain streams and irrigation ditches. Also they have been found in drainage water, slowly flowing streams with sandy or stony bottoms, and in ponds with aquatic vegetation. This mosquito occurs either on the plains or in the mountains. In Formosa Anazawa (1931) has found that the females remain in the stables or dwellings after obtaining their blood meal. He found a natural infection rate of 2.3 percent (second only to minimus) and experimental infection of 57 percent with vivax,

36 percent with malariae, and 27 percent with falciparum. Both animals and man are attacked by females. Morishita (1936) states that it is widespread over the entire island. Although Koidzumi (1927) regarded it as a rare form, its widespread range and the observed rate of natural infection demand that it be provisionally recognized as an important vector in spite of the fact that it is not so regarded elsewhere.

5. Anopheles ludlowii. This is a fresh water species known only from the Philippines, Ceram, Formosa, and possibly Hainan. In Formosa it was known for many years as Anopheles hatorii. Anopheles ludlowii should not be confused with the so-called "ludlowi" (sundaicus) of many authors which is the important malaria vector of Malaya and the Malay Archipelago. In the Philippines, Anopheles ludlowii larvae are found in the clear water of shaded or exposed streams or rivers, sometimes in pools. The larvae seem to prefer the wider parts of the streams where the water is stagnant. Anopheles ludlowii is not regarded as a vector of malaria in the Philippines where all dissections have been negative. Anazawa (1931), however, has reported a rate of natural infection of 0.4 percent. Experimentally (1931) infections of 61 percent with vivax, 15 percent with malariae, and 68 percent with falciparum were obtained. Morishita and Katakai (1933) have shown that it has a definite preference for the blood of cattle and water buffalo and rarely, if ever, attacks man. It has been recorded from the central, southern, and eastern parts of Formosa including the eastern part of Taihoku Prefecture. According to Koidzumi (1927) it is common in the central and southern parts (next to minimus and maculatus) and along the east coast and rare in the northern part. It is probable that Anopheles ludlowii will not prove to be a vector of importance in Formosa.

6. Anopheles jeyporiensis candidiensis. Little has been published concerning the breeding habits of this subspecies. Apparently larvae have been found in slowly flowing streams and grassy irrigation ditches. In Hong Kong the females of this species are known to be domestic in their habits; more than 50 percent were found with human blood. In many areas in southern China it is regarded as second in importance only to Anopheles minimus as a vector. According to Morishita (1936) candidiensis has been found only in a few localities in Taichu-Shu. Because of this limited distribution it does not appear that this species will be found to be an important vector of malaria in Formosa.

7. Anopheles annularis. The larvae of this species are usually found in clean, weed-grown, stagnant, quiet water, particularly, margins of lakes, tanks, moats, dead rivers, swamps, rice fields, ponds, pools, in rivers when there is vegetation, etc. In Indo-China they have been found in tree holes and bamboo stumps. The females were found by Anazawa (1931) in Formosa to be more zoophilic than anthropophilic; biting occurs daytimes as well as at night. Natural infections of 0.2 percent have been found in Formosa by Anazawa (1931). His data on artificial infections show rates of 56 percent for vivax, 20 percent for malariae, and 89 percent for falciparum. Morishita's data (1936) show that annularis is found throughout Formosa although it is rare in the northern part of the island. Because of its low natural infection it is probably unimportant as a vector although it should not be overlooked as a possibility.

8. Anopheles tessellatus. The larvae of this species occur most frequently in small pools, irrigation ditches and drains, and swamps. Little is known of the habits of the adults. In the Netherlands Indies and Indo-China they are thought to attack cattle and buffalo in preference to other sources of blood. These observations have been confirmed by Morishita and Katakai (1936) although Anazawa (1931) thought that they are more anthropophilic. The females tend to remain in the dwellings and stables after feeding. Anazawa (1931) observed a natural infection rate in Formosa of 1.9 percent somewhat higher than observations elsewhere. Because of this and its widespread distribution throughout the island it should be regarded as a vector of potential importance. Koidzumi (1927) says that it occurs throughout the island in the plains and foothills. Frequently it is more numerous around the cities and villages.

CHAPTER III

FILARIASIS

Reports are not in precise agreement as to the status of filariasis in Formosa. Yokogawa and Morishita (1931-1933), Japanese parasitologists who have made extensive studies in Formosa, stated that although this disease is common in the Loochoo Islands, southern Japan, China, and the Philippine Islands, it is surprisingly uncommon in Formosa. However, they do give records of several cases. Later Yokogawa et al (1939) in discussing their investigations in the Bōko Islands state that Formosa "was believed to be free of filariasis". Another report of undetermined origin and authenticity states that filariasis does occur in Formosa to a limited extent and is more common in the southern part of the island. Yokogawa and Morishita (1931-1933) also pointed out that many of the cases reported from Formosa have been allochthonous although they seem to imply in this treatise that there have also been autochthonous cases. These authors are unable to offer an explanation for the low incidence of filariasis in Formosa in view of the surrounding endemic regions pointing out that Culex quinquefasciatus, which has been shown in Formosa to develop infective larvae, is such a common mosquito. The filariasis of Formosa is caused by Wuchereria bancrofti. No information could be found concerning the periodicity of the microfilariae, although the filariasis of the Loochoo Islands and the Bōko Islands has been observed to be nocturnal.

In the Loochoo Islands filariasis is highly endemic. Ohama (1939) reported microfilaria indices of 20 percent and 12 percent among the school children of Kabira and Taketomi respectively. The same author (1941) found a microfilaria index of 24 percent among the school children in Sirara. Yosino and Nakasato (1941) have reported indices as high as 29 percent in the Loochoo Islands.

The story of filariasis in the Bōko Islands is very interesting and may lend some light to the situation on the main island of Formosa. Tanaka (1937) reported that prior to 1937 only a single case had been reported but that one would expect the disease to be there because of the geographical position of the islands as well as the abundance of Culex quinquefasciatus. In an examination of 229 individuals made by this investigator 43 percent were found to have "signs" of filariasis and 16 percent had microfilaria in the night blood. He concluded the islands to be highly endemic. The same author (1938) reported eight cases from the Bōko Naval Station, one of which showed no periodicity. The others were of the nocturnal type. During the summer a large group of investigators under the direction of Yokogawa (1939) made a filariasis survey of the Bōko Islands. The results are as follows:

TABLE V

Microfilaria survey in the Bōko Islands

Island	Village	Number Examined	Type	Percent Positive
Hakusya	Gado	340	Adults	7.35
Hakusya	Gado	117	School Children	0.85
Bōko	Makō	1,235	School Children	9.55
Bōko	Kosei	867	School Children	11.22
Gyoō	Gōkaito	40	School Children	1.25

In view of the fact that before 1936 filariasis was assumed not to occur in the Bōko Islands only to be subsequently found as prevalent, the possibility arises that a similar condition could exist on the main island. Certainly this possibility is sufficiently plausible to warrant some attention at the time of occupation.

VECTORS

As in many areas the question of the intermediate hosts of Wuchereria bancrofti in Formosa is not clear and although there is considerable evidence to implicate Culex quinquefasciatus it should by no means be assumed that this species is necessarily the important vector. Actually, the reported low incidence of filariasis and the abundance of Culex quinquefasciatus, make it difficult to assume that the picture is a simple one. The following notes on the vectors (essential intermediate hosts) of filariasis have been taken from various sources and should be regarded only as suggestions as to species which may serve as vectors.

1. Culex quinquefasciatus. This species is regarded as an important vector in Japan by Esaki (1932), and as a vector in Formosa by Yokogawa and Morishita (1931, 1933), and Abe (1937). It is also thought to be the vector in the Loochoo Islands and Yokogawa et al (1939) regarded it as the vector in the Bōko Islands. Abe's conclusions are based on experiments in which he was able to demonstrate the development of infective larvae in the females. Culex quinquefasciatus is a cosmotropical and subtropical species and is ubiquitous in its breeding habits. Larvae are found in all sorts of accumulations of water such as tanks, wells, pits, water barrels, toilets, fountains, cisterns, ponds, canals, ditches, and other fresh water habitats. It has been reported as common on the main island of Formosa as well as in the Bōko Islands and the Loochoo Archipelago.

2. Anopheles hyrcanus sinensis. This subspecies has been reported as a vector in China and elsewhere in the orient. Esaki (1932) lists it as possibly a vector in Japan and Formosa although Midzuki and Mihara (1927) regarded it as an important vector. The habits and distribution of this species are discussed in the chapter on malaria.

3. Culex vishnui. This species has been found with infective larvae on Kabaena near Celebes by Brug (1938). However, according to Esaki (1932), only partial development of the larvae has been observed in Japan and Formosa. Culex vishnui has been reported from Formosa.

4 Culex pipiens. This species is regarded as a vector in southern Japan by Esaki (1932). However, no records could be found of its occurrence in Formosa.

5. Culex whitmorei. Esaki (1932) includes this species in his list of vectors of Wuchereria bancrofti although the authority for the statement is not given. Brug (1938) was able to get experimental infections and the development of infective larvae with this species on Kabaena Island near Celebes. Culex whitmorei is reported from Formosa in Esaki's compilation although there is no information concerning its abundance and distribution.

6. Culex tritaeniorhynchus. Esaki (1932) also lists this species from Formosa and designates it as "possibly an intermediate host" of Wuchereria bancrofti. Brug's (1938) experiments lead him to describe it as a possible experimental vector.

7. Culex tipuliformis. This species has been reported from Japan, South China, and India and is listed by Esaki (1932) as a vector of filariasis. It is possible that this species may ultimately be found on Formosa.

8. Mansonia uniformis. This widespread species has been recorded in Formosa. Although Brug does not regard any of the Mansonia species as vector of Wuchereria bancrofti in the Netherlands, Esaki (1932) lists it as a possible vector in the Japanese Empire.

9. Aëdes togoi. Yamada (1921) has apparently demonstrated that this mosquito can be an intermediate host of Wuchereria bancrofti, and it is included in Esaki's list of vectors. Data are not available concerning its abundance in Formosa although there are records from the island. Aëdes togoi is anthropophilic and attacks during the day as well as night by artificial light.

Esaki (1932) lists the following Formosan mosquitoes in which partial development of the larvae has been observed: Culex bitaeniorhynchus karatsuensis, Culex sitiens, Culex vishnui, and Armigeres obturbans.

CHAPTER IV

DENGUE AND YELLOW FEVER

Epidemics as well as sporadic cases of dengue occur in Formosa, as well as in the Pescadores and Loochoo (Ryukyu) Islands. According to Matsumoto (1935) the epidemics in Formosa occur in the southern part of the island. The disease seems to be particularly prevalent in the latter group where Miyao (1931) and Kitano (1931) reported an epidemic involving more than 35,000 cases occurred in 1931. An epidemic in the Pescadores in 1922 as described by Goto (1923) involved more than one-third of the entire population. The 1931 epidemic also swept through parts of Formosa proper and has been described by Suenaga (1931) and Akasi (1932). It was associated with high temperature, rainfall, and humidity.

Miyao (1931) and Koidzumi (1918) state that both Aëdes albopictus and Aëdes aegypti occur in Formosa and the Loochoo Islands. Both are regarded here, as elsewhere, as vectors of dengue.

Aëdes aegypti (=Stegomyia fasciata) is cosmopolitan in its distribution between 40° N. and 40° S. latitude. More is known of its habits and biology than of any mosquito. Its habits are apparently no different in Formosa than elsewhere. Larvae can be found in all types of artificial accumulations of water even in minute volumes. Typical breeding places are rain barrels, tanks, cisterns, tin cans, urns, as well as water accumulated on leaves and in plant axils. It is almost exclusively a house mosquito and is rarely found more than 1500 feet from habitations of some type or other. It is strongly anthropophilic. The younger adults are apparently daytime fliers until a meal of blood is secured and is thereafter nocturnal. It is said to prefer to attack whites in preference to dark-skinned people. There are sufficient records to allow the conclusion that this species is widespread in Formosa. According to Esaki (1932) it is also common in the Pescadores Islands.

Aëdes albopictus, also regarded as a vector in Formosa, has not been reported as frequently as aegypti. However, Esaki (1932) describes it as a common mosquito in Formosa. It breeds near dwellings, frequently in habitats similar to those of Aëdes aegypti. Larvae are found in water tanks, tin cans, cisterns, plant axils, rain barrels, etc., and rarely in ponds, ditches, and mud puddles. It is also strongly anthropophilic and its bite is more irritating than that of aegypti.

YELLOW FEVER

No authentic reports of yellow fever have been found from Formosa or any of the adjoining areas.

Aëdes aegypti known to be a vector elsewhere is common in Formosa and the introduction of yellow fever would doubtlessly result in its rapid spread through the native population.

CHAPTER V

TSUTSUGAMUSHI DISEASE AND OTHER RICKETTSIOSES

Tsutsugamushi disease has been known in Formosa since 1908. Hatori (1919) has described the early history of the disease in Formosa and outlined accurately its epidemiology and distribution. Kawamura and Yamaguchi (1921) showed that it was identical or at least very similar to the tsutsugamushi disease of Japan. The best general account of tsutsugamushi disease in Formosa is that of Morishita (1942, 1939, 1939).

In contrast to the situation in Japan where it is confined to the flood plains of certain rivers, tsutsugamushi disease has a much more general occurrence in Formosa. It occurs not only in the plains but also in the mountainous regions. It is endemic in all five prefectures and the two districts of the main island. The endemic areas are poorly defined. The physical features of the endemic areas vary greatly including riversides, cultivated fields, foothills, jungles both in the plain and in the mountains as high as 6,500 feet. According to Morishita (1942) the majority of the cases come from the plains and foothill districts of the Karenko and Taitō districts in the east, although it occurs also in the mountainous regions of Tainan, Taichu, and Shinchiku prefectures in the middle of the islands and in the plains and foothill regions of Takao prefecture in the south. The incidence of tsutsugamushi disease in Formosa is low; it is a relatively unimportant cause of morbidity and mortality. The statistics in the following table are from Morishita (1942):

TABLE VI

Annual Number of Cases of Tsutsugamushi on the Main Island

Year	Cases	Deaths	Case Fatality in Percent
1923	67	12	17.9
1924	88	8	9.9
1925	81	17	21.0
1926	72	6	8.3
1927	95	9	9.5
1928	72	7	9.7
1929	84	11	13.1
1930	74	6	8.1
1931	82	5	6.1
1932	163	13	8.0
1933	49	5	10.2
1934	35	4	11.4
1935	18	0	0.
1936	26	2	7.7
1937	16	4	25.0
1938	22	6	27.5

Despite its low incidence tsutsugamushi disease should be regarded as a disease of great potential importance to Naval personnel who are required to enter the habitats frequented by the larvae of Trombicula akamushi, the vector.

In Formosa the disease occurs throughout the year, the seasonal peak comes between July and October as shown in the following table.

TABLE VII

Seasonal Occurrence of Tsutsugamushi Disease from 1933-1938

Month	Cases	Percent
January	19	11.4
February	2	1.2
March	1	0.6
April	4	2.4
May	14	8.4
June	20	12.0
July	25	15.1
August	16	9.6
September	14	8.4
October	23	13.9
November	18	10.8
December	10	6.0

In general about five times as many cases occur among men as among women. More than fifty percent of the cases are in the 21 to 35 age groups. Both of these observations can probably be explained on the basis of greater probability of the exposure of males of these age groups to the habitats of the mite larvae. Case fatality increases, according to Morishita, from 3.3 percent in the 1-5 year age group to 45 percent in cases over 45 years of age. It is interesting to note that the case fatality among the Japanese is 10.3 percent, 20.4 percent among the Formosan Chinese, and nil among the aborigines.

THE VECTOR

The only known vector of tsutsugamushi disease in Formosa is the hexapod larva (chigger) of Trombicula akamushi (Brumpt), also the vector in Japan. The chigger feeds once only during its lifetime and the rickettsiae are passed from female to offspring via the ova.

The eggs of Trombicula akamushi are laid singly in the soil. The orange-red hexapod larvae (chiggers)which emerge from the eggs vary in length from 0.30 to 0.40 mm. These larvae are very active and run about on the ground litter and to a certain extent on the lower vegetation. These larvae are known

to attack a considerable variety of warm blooded vertebrates. Digestive fluids are injected into the tissue of the host and the resulting semi-digested material is withdrawn by the mite larvae. After becoming fully engorged the larvae drop to the ground and become quiescent. During the ensuing period the appendages and certain other organs undergo histolysis. When the appendages reform they lie next to the body under the larvae skin and have no setae or armature of any kind. This stage is known as the nymphochrysalis. From the nymphochrysalis emerges the active octopod nymph which is similar to the adult although smaller. This numph remains in the soil and feeds on the juices of plants, particularly those of the roots. The nymphs evolve into the adults which also live in the soil. The sexes are externally similar except for slight differences in the genital region. In the temperate regions there is a single generation per year. Most of the summer is passed in the larval stage and the winter in the adult stage. In Formosa, however, it is probable that there is more than one generation per year.

In Formosa Trombicula akamushi larvae has been found parasitizing the common Indian rat, Rattus rattus rufescens; the Norway rat, Rattus norvegicus, as well as Rattus losea, Rattus coxinga, Apodemus agrarius, Mus musculus, as well as dogs, cats, calves, oxen and buffalo. They have also been found on two insectivores, Suncus myosurus and Crocidura tanakae as well as on quail, pheasants, goatsuckers, kingfishers, cuckals, and the domestic fowl.

In the endemic areas Morishita (1942) has noted Rattus losea and Apodemus agrarius to be common and has suspected them as being reservoir hosts of the Rickettsia tsutsugamushi. He was able to isolate a strain of Rickettsia tsutsugamushi from Rattus losea. Hayashi (1926) has pointed out that birds may be of epidemiological importance not only as hosts of the mites but possibly also as reservoir hosts of the rickettsiae.

TSUTSUGAMUSHI DISEASE
in the Bōko Islands. (Pescadores)

Because of the mild nature of the disease in the Bōko Islands, it was not detected there until 1931. The best accounts of the disease as it occurs on these islands are those of Kawamura and Yamamiya (1939) and Morishita (1942). The epidemiology of tsutsugamushi disease in the Bōko Islands is strikingly different from that of the main island. The dwellings are directly surrounded by endemic areas so that all individuals are exposed to infection without regard to age, sex, or occupation. The case fatality is low (about 5 percent). This is probably due to the milder strain of Rickettsia tsutsugamushi and further to the fact that the majority of the cases (seventy percent) occur in children of fifteen years or less, thirty-eight percent occur in children of less than five years. The disease is seasonal in Bōko with all of the cases thus far recorded having occurred from April to November. The majority of the cases occur in June and July. The monsoon season is from October to March. The following statistics were compiled by Morishita (1942):

TABLE VIII

Annual Number of Cases in the Bōko Islands

Year	Cases	Deaths	Case Fatality Percent
1932	17	1	5.9
1933	12	0	0.
1934	20	1	5.0
1935	55	0	0.
1936	64	5	7.8
1937	80	2	2.5
1938	33	7	21.2
Total	284	16	5.6

The vector of tsutsugamushi disease in the Pescadores is also the larvae of Trombicula akamushi. The larvae apparently develop in the ground within the coral walls which surround the dwellings and gardens of the natives. Rattus rattus rufescens, a semi-domestic form, has been found to be heavily infested with the mite larvae and rickettsiae have been found in its tissues. The other rodents are Mus musculus, the house mouse; and Rattus norvegicus. There are no wild rodents. Morishita (1942) is inclined to feel that rufescens is important in the epidemiology of tsutsugamushi disease in the Bōko Islands.

OTHER RICKETTSIOSES

The official reports of the Formosan government from 1913 to 1937 contain a single record of typhus, one case reported in 1914. Asano (1940) says that it was first reported from Formosa in 1909-1910. He includes Formosa in his list of endemic localities. It appears that his reference is to endemic typhus. Several species of rats known to be potential reservoirs of endemic typhus are known to occur in Formosa. (See chapter on Animals of Medical Importance.) According to Sugimoto, Xenopsylla cheopis, the rat-to-man vector of endemic typhus, occurs in Formosa (Taihoku) although Esaki (1932) indicates that it is confined to the port cities. Ōmori (1936) also has reported it from Formosa. There is also the constant possibility of the introduction of endemic typhus from the endemic areas in China, Japan proper, and other parts of the orient. According to Esaki (1932) the body louse, Pediculus humanus corporis, the vector of epidemic typhus, also occurs in Formosa. This raises the possibility of the introduction of epidemic typhus.

Ohshiro (1931) has reported five cases of a so-called "indistinct fever" in Karenko and on the Bōko Islands. Because of the strong positive Weil-Felix reaction (type not specified) the author was inclined to regard the disease as a "mild form of exanthematous typhus". Whether these cases were actually a mild type of tsutsugamushi disease, endemic typhus or some other disease it is not possible to ascertain from the description.

CHAPTER VI

OTHER ARTHROPOD-BORNE DISEASES

Plague. The last officially reported cases of plague in Formosa were recorded in 1917. The following table gives the official case records for the period 1913-1918 inclusive:

TABLE IX

Plague in Formosa
1913-1918

Year	Cases	Deaths
1913	136	125
1914	567	488
1915	74	66
1916	5	4
1917	7	7
1918	0	0

Prior to 1913 the disease was more prevalent. For example, in 1906, 3,271 cases and 2,613 deaths were recorded.

Although no cases of plague have been officially reported from 1918 through 1938, the last year for which data are available, there is the possibility that it has been reintroduced since that time or that it will be reintroduced subsequently under wartime conditions. The necessary murine reservoirs are present as well as the tropical rat flea, Xenopsylla cheopis, which is the rat-to-man vector.

Tick-borne relapsing fever. The official reports of the Formosan government contain no records of cases of this disease nor could any be found in the literature. Furthermore, no records of Ornithodorus species have been found in the literature.

Louse-borne relapsing fever. The official reports of the Government of Formosa contain no records of this disease. Furthermore no records of cases could be found in the literature. The body louse, Pediculus humanus corporis, which is the vector, is known to occur in Formosa.

Leishmaniasis. Matsunaga (1935) points out that although leishmaniasis (kala-azar) occurs in China and Manchukuo there are no authentic records of it in the Japanese Empire including Formosa.

Tick-borne typhus. No records of this disease in Formosa have been found.

Chaga's disease, Loiasis, and Onchocerciasis also appear to be unreported in Formosa.

CHAPTER VII

THE ENTERIC DISEASES
(Except Helminthiasis)

That the enteric diseases have been for sometime an important cause of death in Formosa is evidenced by the following figures taken from Taiwan Sotokufu Tokeisho (Statistical Report of the Formosa Government) for 1934.

TABLE X

Year	Total Population of Formosa	Deaths from Typhoid	Para-typhoid	Dysentery	Ekiri	Diarrhoea Enteritis
1932	4,932,433	206	9	45	30	16,394
		Rate per 1,000	Rate per 1,000	Rate per 1,000	Rate per 1,000	Rate per 1,000
		0.04	0.002	0.009	0.006	3.32

The great majority of the deaths from these diseases have, however, been in infants. Thus of the 16,394 deaths from diarrhoea and enteritis in 1932, 11,490 occurred in infants under 2 and 4,904 occurred in persons 2 years of age or older. Furthermore most of these deaths have been chargeable not to the specific infections (typhoid, paratyphoid, bacillary dysentery, and amoebic dysentery) but to the non-specific infectious ekiri of infants and diarrhoea and enteritis.

DIARRHOEA AND ENTERITIS

The deaths from diarrhoea and enteritis appear to follow a seasonal trend with the peak being reached sometime during May, June or July. Thus the Statistical Report of the Formosa Government, 1934, records that the deaths each month in 1932 from diarrhoea and enteritis were as follows:

TABLE XI

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
758	625	657	1147	2798	2358	2131	1636	1257	1117	1082	828

The distribution of the deaths from diarrhoea and enteritis through the eight (8) different prefectures was as follows in 1932 (Statistical Report of the Formosa Government, 1934):

TABLE XII

	Taihoku	Shin-chiku	Taichu	Tainan	Takao	Taitō	Karenko	Bōko
Deaths	2,062	1,076	3,700	6,262	2,606	190	192	298
Rate per 1,000	2.09	1.52	3.38	5.04	3.87	3.03	2.01	4.58

No figures are available as to the mortality from diarrhoea and enteritis in Formosa since 1932.

TYPHOID AND PARATYPHOID FEVERS

Typhoid fever and paratyphoid fever have not been diseases of first importance in Formosa during the last 11 years (1928-1938 inclusive) for which figures are available (see Table). No evidence, however, of a decreasing trend either in the incidence of or mortality from these diseases is discernible even if figures are consulted as far back as 1913.

TABLE XIII

Reported cases and deaths due to typhoid and paratyphoid fever in Formosa*

Year	Total Population	Typhoid Fever			Paratyphoid Fever		
		Cases	Deaths	Death rate per 1,000	Cases	Deaths	Death rate per 1,000
1928	4,438,084	1,643	297	0.07	222	14	0.003
1929	4,548,750	1,454	315	0.07	149	27	0.006
1930	4,679,066	1,719	323	0.07	141	16	0.003
1931	4,803,976	1,100	243	0.05	79	8	0.002
1932	4,929,962	1,074	223	0.05	107	26	0.005
1933	5,060,507	1,139	246	0.05	32	8	0.002
1934	5,194,980	1,162	301	0.06	38	8	0.002
1935	5,315,642	1,450	328	0.06	55	7	0.001
1936	5,451,863	1,822	432	0.08	48	5	0.001
1937	5,609,042	1,475	349	0.06	45	15	0.003
1938	5,746,959	1,617	0	0.	93	0	0.

*From the Statistical Yearbook of the Japanese Empire.

Among the Japanese in Formosa it is apparently those who have been in residence less than 5 years who show the highest rate of incidence for typhoid.

TABLE XIV

Number of Cases of Typhoid and Period of Residence in Formosa*

Period of Residence	Population	Number of Cases	Percent of total number of patients	Number of cases per 1,000 population
Less than 6 months		85	29.40	
6 mos. to 1 year		82		
1 year to 2 years		67	18.67	
2 years to 3 years		47	10.09	
3 years to 4 years		41	9.00	
4 years to 5 years		30	6.44	
Less than 5 years	60,265	342		5.7
5 to 10 years	26,440	87		3.3
10 years to 15 years	11,932	23		1.9
15 years to 20 years	11,802	13		1.1

*Maruyama Y. 1920. Tokyoer Medizinische Wochenschrift, Tokyo, No. 2163:297-300.

Some evidence as to the seasonal prevalence is provided in the following figures:

TABLE XV

Deaths from Typhoid and Paratyphoid Fever, Formosa, 1932*

Type	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Typhoid	13	8	6	3	8	16	20	23	39	29	21	20
Para-typhoid	-	1	-	-	-	2	1	2	1	-	1	1
Total disease deaths	8113	6680	7728	7322	9832	9509	10021	9157	7612	7634	7590	7927

*Taiwan Sotokufu Tokeisho
(Statistical Report of the Formosa Government, 1934)

TABLE XVI

Seasonal Distribution of 724 Cases of Typhoid and Paratyphoid Admitted to Child Dept. Taihoku Hospital, 1917 to 1928*

Type	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Typhoid	38	29	25	28	59	81	72	62	53	38	39	47	571
Para-typhoid	6	3	8	6	13	35	24	17	9	6	20	6	153
Total	44	32	33	34	72	116	96	79	62	44	59	53	724
Percent	6.07	4.41	4.55	4.69	9.94	16.02	13.25	10.91	8.56	6.07	8.14	7.32	

*Chin, Kyu-Sui Feb., 1929
Taiwan Igakkai Zassi (Jour. Med. Assoc. Formosa), Taihoku, No. 287:175-206.

TABLE XVII

The distribution of the typhoid and paratyphoid deaths among the 8 prefectures of Formosa in 1932 was as follows:

Deaths	Taiho-ku	Shin-chiku	Taichu	Tainan	Takao	Taitō	Karenko	Bōko
Typhoid	126	5	15	35	12	3	9	1
Para-typhoid	6	-	-	2	1	-	-	-
Death rate per 1,000								
Typhoid	0.13	0.007	0.01	0.03	0.02	0.05	0.09	0.02
Para-typhoid	0.006	-	-	0.002	0.001	-	-	-

*Taiwan Sotokufu Tokeisho
(Statistical Report of the Formosa Government, 1934)

The following information is available on the types of B. typhosus isolated from cases of typhoid fever: T. Mori (in the Taiwan Igakkai Zassi (Journal of Med. Assoc., Formosa, 37(7):1112-1117)) reported that he had isolated 99 strains of B. typhosus from cases of typhoid fever in the Takao Hospital during 1936-37. It was found that 57 strains belonged to Type I, 36 to Type V, 3 to Type VI, and one each to Type II, III and XI. These types are according to Shimojo and Soda's classification which is as follows:

TABLE XVIII

Cultures	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Xylose	+	+	+	+	-	-	-	-	+	+	-	-
Teruchi-agar	+	+	-	-	+	+	-	-	-	-	-	-
Gelatin	+	-	+	-	+	-	+	-	+	-	+	-
Witte-agar	+	+	+	+	+	+	+	+	-	-	-	-
Endo-agar	+	+	+	+	+	+	+	+	+	+	+	+

Kazuo Kubota (1940) reported on 162 hospitalized cases of typhoid fever with the following conclusions:

(1) The mortality was 28.40 ± 3.53 percent.
(2) The mortality was 18.35 ± 6.90 percent greater in the Formosan Chinese than among the Japanese.
(3) The average time of hospitalization was 47.3 days for those who recovered and 19.1 days for the fatal cases.
(4) Using Shimojo and Soda's classification.

61 percent of cases were Type I
21 percent of cases were Type V
15 percent of cases were Type VI
1 percent of cases were Type II
1 percent of cases were Type III
1 percent of cases were Type XII

DYSENTERY

The incidence of dysentery and the mortality from the disease has been rather slight in Formosa since 1928 (see Table XIX).

TABLE XIX

Reported cases and deaths due to dysentery in Formosa*

Year	Population	Cases	Rate per 1,000	Number of deaths	Death rate per 1,000
1928	4,438,084	129	0.03	13	0.003
1929	4,548,750	202	0.04	31	0.007
1930	4,679,066	248	0.05	16	0.003
1931	4,803,976	245	0.05	34	0.007
1932	4,929,962	332	0.07	32	0.006
1933	5,060,507	260	0.05	34	0.007
1934	5,194,980	218	0.04	36	0.007
1935	5,315,642	255	0.05	47	0.009
1936	5,451,863	236	0.04	42	0.008
1937	5,609,042	302	0.05	49	0.009
1938	5,746,959	471	0.08	-	0.

*From the Statistical Yearbook of the Japanese Empire.

As far as can be determined from the limited statistics available it would appear: (1) that the season of greatest incidence of dysentery is June, July and August; (2) that the prefecture of Tainan usually reports the greatest number of cases; (3) that the highest death rate from dysentery is in the prefecture of Taitō.

TABLE XX

Year 1932	Taihoku	Shinchiku	Taichu	Tainan	Takao	Taitō	Karenko	Bōko
Deaths from dysentery	11	1	-	27	2	3	1	-
Death rate per 1,000	0.01	0.001	-	0.02	0.003	0.05	0.01	-

(Statistical Report of the Formosa Government, 1934)

As to the types of Shigella isolated from cases of bacillary dysentery only the following data are available:

Uzuhiko Kurimoto and Taizo (1940) classified 61 strains of dysentery bacilli, which were isolated from patients in Taihoku in 1939, after the classification by Futaki:

Types	No. of strains
Shiga-Kruse type	1
Komagome B type	13
Kawase type	1 (mannite-non-fermenter)
Nakamura type	11
Ohara type	4
Serologically not identical with any type	12 (mannite-non-fermenter) 19 (mannite-fermenter)

AMOEBIASES AND OTHER INTESTINAL PROTOZOAN INFECTIONS

It is not possible to indicate the extent of morbidity due to amoebic dysentery because the type of dysentery is not specified in reporting communicable diseases. The prevalence of amebiasis as well as other intestinal protozoan infections is indicated to a certain degree by the results of stool examinations as recorded in the table at the end of this Chapter. Infections with Endamoeba histolytica appear to occur in rates of one to 25 percent varying according to locality and the type of people examined. Considerable attention has been given to giardiasis which has been found to be prevalent in some areas, especially among children. Balantidium coli has been reported infrequently in humans although it is common in swine (60 percent in southern Formosa).

CHOLERA

Large epidemics of cholera were at one time known to ravage the island of Formosa. The last large epidemic was that of 1919-20 when 6,507 cases and 4,364 deaths were officially reported. Since that time sporadic cases have appeared in small numbers, particularly in the seaport cities.

The following table is a compilation of cholera statistics of the Government of Formosa:

TABLE XXI

Cholera in Formosa

Year	Cases	Deaths	Year	Cases	Deaths
1913	-	-	1926	16	11
1914	-	-	1927	-	-
1915	-	-	1928	-	-
1916	34	16	1929	-	-
1917	2	1	1930	-	-
1918	1	1	1931	1	1
1919	3,836	2,693	1932	16	6
1920	2,671	1,671	1933	-	-
1921	1	-	1934	-	-
1922	-	-	1935	-	-
1923	-	-	1936	-	-
1924	-	-	1937	-	-
1925	3	3			

Because of the proximity of Formosa to the Chinese mainland, there is the constant danger of the introduction of cholera especially by the smaller native craft. This danger will doubtlessly be enhanced by wartime conditions when maintenance of inspection is difficult.

SANITATION IN RELATION TO ENTERIC DISEASES

Though water purification plants provide water of sanitary quality in the larger cities, the majority of Formosa's rural inhabitants apparently drink untreated well or stream water. The sanitary quality of the well water apparently varies considerably but is superior to that of the stream water which suffers general contamination as the result of the unsanitary methods in general use for disposing of human fecal material. In rural areas sanitary privies or bored-hole latrines are still not in universal use and in the larger towns and villages the night soil from each house is collected into large tanks, is allowed to putrify and is then spread over the land as fertilizer.

The failure to provide sanitary disposal of fecal material coupled with the presence of pigsties serves to make the fly problem a serious one. The chief species of flies are discussed in Chapter XII.

TABLE XXII

Incidence of intestinal protozoa as ascertained by fecal examinations.

Locality	Number examined	Description	Endamoeba histolytica	Endamoeba coli	Endolimax nana	Iodamoeba buetschlii	Dientamoeba fragilis	Giardia lamblia	Balantidium coli	Trichomonas	Reference
			Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	
Hozan (S. Formosa)	40	Japanese marines	0.	12.5	25.0	10.0	-	5.0	-	-	Kan (1934)
Hozan (S. Formosa)	156*	schoolchildren	18.6	39.7	14.1	23.7	-	30.1	-	-	Kan (1934)
North Formosa	616		16.7	11.4	16.7	1.5	-	6.2	-	2.8	Kawai et al (1936)
Taihoku	259	medical students	8.5	8.5	8.1	2.0	-	4.6	-	-	Morioka et al (1936)
Tainan	429	prisoners	18.0	6.3	5.6	-	0.7	9.0	1.0	0.7	Namikawa (1936)
Taihoku	971	Japanese schoolchildren	1.2	3.4	4.3	0.3	-	10.5	-	0.	Narihara et al (1938)
Taihoku	1,363	Chinese schoolchildren	5.5	8.3	12.2	0.8	-	15.6	-	0.4	Narihara et al (1938)
Hokuto	**	male schoolchildren	3.0	10.6	0.	-	-	15.2	-	-	Ro (1940)
Hokuto	***	female schoolchildren	1.9	11.5	3.8	-	-	12.8	-	-	Ro (1940)
North Formosa	139	"rural persons"	11.5	13.7	2.9	1.4	-	2.2	-	-	Wakeshima& Koo (1933)

* 1 case with Chilomastix mesnili.
** 0.5 percent " "
*** 0.6 percent " "

CHAPTER VIII

THE ACUTE RESPIRATORY DISEASES AND TUBERCULOSIS

The acute respiratory diseases appear to be the major cause of death in Formosa. In the years 1932, 1933, and 1934 approximately 25,000 deaths per year were reported as the result of these infections, yet it is likely that this figure fails to include many respiratory disease deaths.

TABLE XXIII

Deaths from Acute Respiratory Diseases in Formosa
(Japanese Year Book, 1933, 1934, 1935)

	1932		1933		1934	
Disease	Deaths	Rate per 1,000	Deaths	Rate per 1,000	Deaths	Rate per 1,000
Influenza	222	0.05	209	0.04	236	0.05
Bronchitis*	4,980	1.08	4,855	0.96	5,143	1.02
Bronchitis, acute	1,027	0.22	0	0.	0	0.
Pneumonia	17,877	3.89	17,862	3.53	22,934	4.53
Pleurisy	1,298	0.28	1,629	0.32	1,815	0.36

*The figures for bronchitis appear to include also the figures for bronchitis, acute.

That there is but little seasonal change in the death rates for the Island as a whole from the acute respiratory diseases is evidenced by the following monthly death rates for 1932 (from the Statistical Report of the Formosa Government, 1934):

TABLE XXIV

Disease	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Influenza	8	8	19	12	16	36	44	12	9	6	20	22
Bronchitis*	552	418	497	387	372	360	439	383	296	373	405	498
Bronchitis, acute	101	87	96	79	70	70	94	76	63	92	101	98
Pneumonia	1537	1334	1829	1609	1750	1673	1774	1361	1094	1175	1228	1510
Pleurisy	113	99	139	114	128	128	112	111	86	81	93	94

*The figures for bronchitis appear to include also the figures for bronchitis, acute.

The relative size of the respiratory disease problem in the different prefectures is somewhat shown by the following figures (Statistical Report of the Formosa Government, 1934):

TABLE XXV

Deaths from Acute Respiratory Diseases in Formosa, 1932.

Disease	Taihoku		Shinchiku		Taichu		Tainan		Takao		Taitō		Karenko		Bōko	
	Deaths	Rate per 1,000	Deaths	Rate per 1,000	Deaths	Rate per 1,000	Deaths	Rate per 1,000	Deaths	Rate per 1,000	Deaths	Rate per 1,000	Deaths	Rate per 1,000	Deaths	Rate per 1,000
Influenza	82	0.08	25	0.04	19	0.02	55	0.04	29	0.04	4	0.06	8	0.08	-	-
Bronchitis*	980	0.99	619	0.87	1,125	1.03	1,362	1.10	736	1.09	37	0.59	60	0.63	61	0.94
Bronchitis, acute	264	0.27	94	0.13	174	0.16	296	0.24	156	0.23	20	0.32	5	0.05	18	0.28
Pneumonia	3,083	3.12	1,937	2.73	4,259	3.89	5,484	4.42	2,547	3.78	179	2.86	259	2.72	129	1.98
Pleurisy	281	0.28	86	0.12	352	0.32	390	0.31	156	0.23	4	0.06	14	0.15	15	0.23

*The figures for bronchitis appear to include also the figures for bronchitis, acute.

The respiratory disease problem would appear to be the most acute in Taichu, Tainan and Takao. It is likely that the marked and rapid variations in temperature and the heavy rainfall contribute to the high mortality from the respiratory diseases in certain localities.

That the death rate from the pneumonias is much greater in Formosa than in the United States is suggested by the following comparison for the year 1932.

TABLE XXVI

Disease	Death rate per 1,000 population	
	U. S.	Formosa
Influenza	0.30	0.05
Bronchitis	0.036	1.08
Pneumonia (all forms)	0.76	3.89
Pleurisy	0.02	0.28

It is probable, however, that since the introduction of the sulfonamides into medical practice these high pneumonia mortality rates have been favorably modified in Formosa as has been the case in the United States.

TUBERCULOSIS

Tuberculosis is a disease of considerable importance in Formosa and the decrease in tuberculosis mortality which has been evident since 1850 in the United States has apparently not occurred in Formosa. Thus we find the pulmonary tuberculosis death rate per 1,000 population recorded as 1.37 percent in 1906, 1.43 percent in 1916, 1.54 percent in 1926 and 1.37 percent in 1935. There has apparently been very little done in the way of public health education regarding tuberculosis and very little provision for early case finding. Our records show only one tuberculosis sanitorium. Careless disposal of sputum and congested living quarters undoubtedly contribute to the high tuberculosis death rate.

TABLE XXVII

Deaths from Tuberculosis in Formosa, 1932
(Statistical Report of the Formosa Government, 1934)

Type	Total Deaths	Rate per 1,000	Japanese	Formosa	Foreigners
Tuberculosis of respiratory system (including trachea, bronchi and lymph nodes)	6,709*	1.46	291	6,341	77
Tuberculosis, pulmonary	6,511	1.42	280	6,160	71
Tuberculosis, of other organs	897	0.20	49	836	12

*This total apparently also includes the total for tuberculosis, pulmonary.

The relatively high mortality suffered from tuberculosis in Formosa is somewhat shown in the following comparison:

TABLE XXVIII

Death Rate per 1,000 Population,
1932

Type	Formosa	United States
Tuberculosis (all forms)	1.66	0.628
Tuberculosis, of respiratory system	1.46	0.564

The distribution of tuberculosis deaths through the eight (8) prefectures of Formosa in 1932 is shown in Table XXX. The deaths would appear to be quite evenly distributed through the prefectures with the exception of Shinchiku. This prefecture appears to have a low rate, more comparable to that found in the United States.

If we accept the commonly used thumb-rule that for every annual death from pulmonary tuberculosis at least six (6) active cases should be discoverable, it would appear that in Formosa in 1932, there were 39,066 active cases of tuberculosis. Of those active cases apparently less than one-fifth were hospitalized (see Table XXIX).

TABLE XXIX

Tuberculosis Cases and Deaths in Government and Other Public Hospitals in Formosa, 1932

(Statistical Report of the Formosa Government, 1934)

Diseases	Government Hospital			Public Hospital Cases	Total Cases
	In-patient		Out-patient Cases		
	Cases	Deaths			
Tuberculosis, pulmonary.....	444	97	1,339	5,667	7,450
Tuberculosis, other than pulmonary....	115	13	506	793	1,414

The amount of tuberculinization of the child population can be roughly estimated from the following results obtained in 1939 in the prefecture of Taihoku. Mantoux testing of over 37,000 school children showed 24.7 percent of the Japanese children and 45.5 percent of the Chinese children to be tuberculin positive.

TABLE XXX

Deaths from Tuberculosis in Various Prefectures of Formosa, 1932

(Statistical Report of the Formosa Government, 1934)

Disease	Taihoku		Shinchiku		Taichu		Tainan		Takao		Taitō		Karenko		Bōko	
	Deaths	Rate per 1000	Deaths	Rate per 1000	Deaths	Rate per 1000	Deaths	Rate per 1000	Deaths	Rate per 1000	Deaths	Rate per 1000	Deaths	Rate per 1000	Deaths	Rate per 1000
Tuberculosis, of respiratory system (including trachea, bronchi, and lymph nodes)	1,424*	1.44	474	0.67	1,461	1.33	2,124	1.71	1,008	1.50	72	1.15	91	0.95	55	0.85
Tuberculosis, pulmonary	1,396	1.41	466	0.66	1,420	1.30	2,052	1.65	1,069	1.59	72	1.15	90	0.94	55	0.85
Tuberculosis, of other organs	209	0.21	127	0.18	186	0.17	239	0.19	96	0.14	7	0.11	20	0.21	13	0.20

* This total also apparently includes the total for tuberculosis, pulmonary.

CHAPTER IX

THE ACUTE INFECTIOUS DISEASES

The statistics of the acute infectious diseases in Formosa are incomplete and open to question since it is admitted that many of the private physicians of the Island are remiss in reporting their cases. It is said that the resistance of many of the private practitioners to reporting their cases is based upon the fact that the policies with regard to disinfecting premises where infectious disease has occurred are extremely drastic and often involve the closing of the house and the confiscation or destruction of food and other supplies.

From the League of Nations Reports the figures in Table XXXI are available.

If we accept these at their face value the following conclusions would appear justified for the eight (8) Reportable Acute Infectious Diseases (smallpox, scarlet fever, diphtheria, cerebrospinal meningitis, encephalitis lethargica, plague, yellow fever, and typhus fever) through the period 1926-1938:

1. Diphtheria stood first both as to incidence and deaths and did not appear to be decreasing; its peak year was 1936.

2. Cerebrospinal fever stood second both as to incidence and deaths and did not appear to be decreasing; its peak year was 1935.

3. Scarlet fever stood third both as to incidence and deaths and did not appear to be decreasing; its peak year was 1934.

4. Smallpox had its peak year in 1926 and was definitely decreasing from 1926-1938. Between 1932 and 1938 the number of cases of smallpox reported annually was negligible.

5. The reports on encephalitis lethargica are only available for three years: 1936, 1937 and 1938; the disease was apparently increasing.

6. There were no cases of plague, yellow fever, or typhus reported through the 13-year period.

Apparently the last smallpox epidemic of serious proportions occurred in 1920 when there was an outbreak of 838 cases.

A slight outbreak occurred in March and April 1939 when 67 cases were reported from the prefecture of Tainan.

TABLE XXXI

Reportable Acute Infectious Diseases in Formosa

(League of Nations Reports)*

Disease	1926		1927		1928		1929		1930		1931		1932		1933		1934		1935		1936		1937		1938	
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
Smallpox	93	-	1	0	1	0	0	0	82	8	2	0	61	8	1	1	5	0	2	1	2	0	0	0	0	
Diphtheria	243	63	411	76	324	65	385	67	402	71	440	104	523	88	660	101	832	141	720	125	865	153	803	137	915	...
Scarlet fever	6	3	9	0	12	1	25	1	23	0	58	4	57	1	66	0	418	12	227	11	63	5	82	3	78	...
Cerebro-spinal meningitis	100	61	33	21	21	14	33	27	11	8	10	6	10	8	20	17	272	167	273	162	198	122	98	50	165	...
Encephalitis lethargica																	...	...	...	...	1	1	27	9	36	...
Plague																										
Yellow fever																										
Typhus																										

* ... signifies "data not yet published or received".

TABLE XXXII

Data on Smallpox Vaccination in Formosa

Year	Total	Positive	Negative
1927	221,348	170,360	50,988
1928	203,424	184,692	18,732
1929	146,383	136,128	10,255
1930	1,058,921	575,808	483,113
1931	328,090	225,307	102,783
1932	910,519	427,163	483,356

The Japanese Year Book reports the following deaths from measles and whooping cough:

TABLE XXXIII

Deaths from Measles and Whooping Cough in Formosa

(Japanese Year Book, 1933, 1934, 1935)

Disease	1932	1933	1934
Measles	730	732	2,320
Whooping cough	393	447	525

It would appear therefore that the nonreportable diseases, measles and whooping cough, each cause more deaths annually than does any one of the reportable acute infectious diseases (including the reportable enteric diseases but excluding diarrhoea and enteritis).

The seasonal incidence of the acute infectious diseases can be somewhat inferred from the following figures for 1932 (Statistical Report of the Formosa Government, 1934). (See Table XXXIV)

TABLE XXXIV

Deaths in Formosa from Acute Infectious Diseases, 1932

Disease	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Smallpox	-	8	-	-	-	-	-	-	-	-	-	-
Measles	119	96	134	75	114	66	61	35	13	5	8	4
Scarlet Fever	-	2	-	-	-	-	-	-	-	-	-	-
Whooping Cough	18	12	26	11	26	28	55	63	29	22	45	58
Diphtheria	11	16	9	4	5	1	6	4	3	9	6	12
Meningitis (excluding tuberculous)	33	41	37	49	61	86	87	70	61	47	51	44

TABLE XXXV

Acute Infectious Disease Deaths in Various Prefectures, Formosa, 1932*

Disease	Taihoku		Shinchiku		Taichu		Tainan		Takao		Taitō		Karenko		Bōko	
	Deaths	Rate per 1,000	Deaths	Rate per 1,000	Deaths	Rate per 1,000	Deaths	Rate per 1,000	Deaths	Rate per 1,000	Deaths	Rate per 1,000	Deaths	Rate per 1,000	Deaths	Rate per 1,000
Smallpox	4	0.004	-	-	-	-	-	-	-	-	-	-	4	0.04	-	-
Measles	47	0.05	43	0.06	323	0.30	257	0.21	35	0.05	16	0.26	6	0.06	3	0.05
Scarlet Fever	1	0.001	-	-	-	-	-	-	-	-	-	-	1	0.01	-	-
Whooping Cough	117	0.12	35	0.05	83	0.08	104	0.08	40	0.06	-	-	8	0.08	6	0.09
Diphtheria	53	0.05	6	0.008	9	0.008	10	0.008	3	0.004	-	-	4	0.04	1	0.02
Meningitis (excluding Tuberculous)	133	0.13	138	0.19	90	0.08	189	0.15	75	0.11	12	0.019	13	0.14	17	0.26

*Statistical Report of the Formosa Government, 1934.

Though no figures showing the actual incidence, distribution and death rate are available for certain of the acute infectious diseases, it is of some interest to show the number of admissions to the Government and Public Hospitals for these diseases as in Table XXXVI.

TABLE XXXVI

Number of Cases of Selected Acute Infectious Diseases Treated (In-patient or Out-patient) at Government or Public Hospitals, Formosa, 1932*

Disease	Number of Cases Treated
Rabies	24
Poliomyelitis	21
Spirochetosis icterohemorrhagica	56
Tetanus	1,143
Mumps	1,342
Erysipelas	1,096
Actinomycosis	130

*Statistical Report of the Formosa Government, 1934.

CHAPTER X

OTHER INFECTIOUS DISEASES

Skin Diseases

Many kinds of skin diseases have been reported from Formosa. Because of nomenclatorial difficulties and a lack of papers containing statistical data, it is not possible to indicate the relative prevalence of the different skin diseases in any degree of accuracy whatsoever.

Among the fungous infections Matsumoto (1939) lists Tinea imbricata, caused by Endodermophyton cruris, from Formosa, although he makes no statement concerning its prevalence. According to the same author favus is a common disease in the coastal areas. Yoh (1940) discussed 388 cases of fungous diseases of the head observed by him in Taihoku Prefecture. The organisms involved were as follows: Grubyella ferruginea (Microsporon ferrugineum), 296; Bodinium violaceum (Trichophyton violaceum), 68; Trichophyton coccidium, 23; Trichophyton glabrum, 1; and Trichophyton gypseum, 1. Takashi and Yoh (1940) studied 947 cases of head fungous infections among native children of central Formosa. The following fungi were cultured: Microsporon ferrugineum, 583; Trichophyton violaceum, 311; and Trichophyton glabrum, 31; and Trichophyton coccidium, 67.

Leprosy. is quite prevalent in Formosa. Matsumoto (1935) gives the incidence as 0.6 percent as compared with 0.55 percent in the Japanese Mandated Islands, and 0.028 percent in Japan proper. The statistics of the Government of Formosa (1934) reveal that there were thirty-five deaths due to leprosy in 1932. Deaths due to leprosy were reported from all prefectures and districts except Karenko, indicating a general distribution of the disease throughout the island. In 1932 there were 179 hospital cases (7 deaths) recorded.

Scabies is said to be common among the Chinese.

Yaws. According to Asai and Chin (1940) yaws now occurs only among the aboriginal Paiwans in the southern mountains of Formosa. According to these authors 1,871 cases from 51 colonies of these natives were treated in 1932. In 1938 at Rikiriki the authors examined 1,700 of the Paiwans and found 107 with yaws. In 1939 they found 139 cases in the same region. Although salvarsan and neosalvarsan have been used extensively among these natives, there are many relapses and many cases seem to be resistant to this type of treatment.

Venereal Diseases

Prostitution is apparently a well-organized and common practice in Formosa. Although periodic physical examinations of prostitutes are required, it is said that in many establishments they are given special treatment prior to the examination and are consequently pronounced free of disease. The majority of the prostitutes examined are Japanese and it appears that the profession is practiced largely by Japanese women. The following table is taken from the statistics of the Formosan Government for 1932.

TABLE XXXVII

Prostitutes Examined in Formosa in 1932

Prefecture	Japanese	Formosan Chinese	Korean
Taihoku	20,724	58	2,071
Taichu	4,555	-	1,013
Tainan	3,751	3,561	1,374
Takao	5,969	-	1,060
Karenko	2,149	-	562
Bōko	5,245	-	-
Total	42,393	3,619	6,080

These data may be misleading since it is possible that in attempting to protect their own personnel, the Japanese may have been more strict in enforcing physical examinations among the Japanese women.

The inefficiency of the system of examination and control is indicated by the fact that only about one-tenth of one percent of the prostitutes examined are reported to have syphilis and only two to three percent to have gonorrhea. Some idea of the prevalence of venereal diseases can be obtained from the data on hospital admissions. In 1932, two percent of all hospital admissions were for gonorrhea, about one percent were for syphilis, and one half of one percent for chancroid.

Trachoma

Trachoma is prevalent in Formosa as well as in other parts of the Japanese Empire. Between eight and nine percent of all admissions (including out-patients) to hospitals are for trachoma. About one-tenth of one percent of the prostitutes examined from 1927 to 1932 were found to have this disease.

CHAPTER XI

HELMINTHIASES
(Except Filariasis)

Helminthiases are common in Formosa. About six percent of all hospital admissions are for intestinal parasitic infections. These conditions warrant that measures be taken to prevent, insofar as possible, these infections among Naval personnel. The helminthiases are not reportable diseases in Formosa and consequently it is necessary to ascertain their prevalence on the basis of results obtained by individual investigations and surveys. The best general sources of information on the prevalence of helminthiases are Yokogawa and Morishita (1931, 1933) and Suzuki (1929).

Nematodes

Nematode infections, in general, are heaviest in Taichu and Taihoku Prefectures, although data are incomplete from Karenko and Taitō Districts. According to Suzuki (1929) infection rates are the highest in the foothill regions where as high as 90 percent of the people may harbor one or more species of parasitic nematodes. About 80 percent of the rural population of the plain areas have nematode infections, and about 75 percent of the people of coastal rural areas harbor one or more species of parasitic round worms. Table XXXVIII gives a general summary of the results of several surveys and investigations.

Hookworm. Necator americanus, Ancylostoma duodenale, and Ancylostoma braziliense are all known ot occur in Formosa. The last was not recorded until 1928 when Yokogawa (1928, 1929) found it among the aborigines in central Formosa. Necator americanus seems to be more common than Ancylostoma duodenale. Ancylostomiasis incidence varies from less than one percent in urban centers to more than sixty percent in rural areas. The highest incidence of ancylostomiasis is found in Taichu prefecture. In this prefecture the rate for the foothill country is 62.8 percent; for the valleys, 60.8 percent; for the plains, 57.6 percent; and in coastal areas 53.7 percent. The second heaviest rate is that of Taihoku. In this prefecture the rate is 27.4 percent in the valleys, 27.5 percent in the foothills, 26.1 percent in the plains, and six percent along the coast. In Takao Prefecture infection rates of 13.5 percent to 17.5 percent were found. In Tainan the rate is 8.6 percent in the plains region (most of the prefecture). Ancylostomiasis was found to be rare in Shinchiku Prefecture by Suzuki (1929). Ōi (1927) records an incidence of 14.5 percent for the Loochoo Islands. Ohama (1940) recorded an incidence of 93 percent on Isigaki Island in the Loochoo Archipelago.

Ascaris lumbricoides. Ascariasis is the most common helminthiasis in Formosa. Rates from 22 percent to 95 percent, varying according to locality and class of people examined, have been recorded. Suzuki (1929) found 75.77 percent of 39,675 persons examined to be harboring this nematode. After six years, age seems to exert little influence on the rate of infection. Ascariasis is slightly more prevalent in the valleys and foothills (over 82 percent) than in rural districts along the coasts (74.5 percent) and on the plains (68.6 percent). Ascariasis is more common in Taichu than in the other prefectures; Taihoku is next. High rates have also been observed in parts of Karenko District.

TABLE XXXVIII

Prevalence of Parasitic Nematodes
as determined by fecal examinations

Locality	Number Examined	Description	Hookworm	Ascaris lumbricoides	Trichuris trichiura	Enterobius vermicularis	Strongyloides stercoralis	Reference
			Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	
Taihoku City	971	Japanese schoolchildren	1.0	22.2	22.1	1.6	-	Narihara et al (1938)
Taihoku "	1,363	Chinese schoolchildren	2.2	53.6	37.8	1.5	-	Narihara et al (1938)
-----	1,434	hospitalized children	1.0	78.1	23.4	6.8	-	Muto (1940)
Shinchiku	2,000	general population	15.0	94.5	-	-	-	Yokogawa et al (1928)
Taihoku	555	outpatients	13.0	35.0	46.5	2.9	1.3	Yamazaki (1925)
Karenko District	716	general population 3 villages	56.0	59.5	74.7	0.6	0.	Oi (1927)
Yoshino (Karenko)	243	schoolchildren	30.0	90.0	86.5	0.8	0.	Oi (1927)
Karenko City	220	hospital patients	25.4	44.0	52.0	0.9	0.4	Oi (1927)
Karenko "	40	fishermen	20.0	45.0	87.5	0.	0.	Oi (1927)
Karenko "	168	schoolchildren	52.2	82.7	88.0	1.2	2.4	Oi (1927)
Karenko District	104	"natives" of plains	55.8	77.8	88.4	1.8	0.	Oi (1927)
Karenko "	77	"natives" of highlands	75.3	20.7	50.7	0.	0.	Oi (1927)
Taihoku City	259	medical students	7.8	22.7	-	-	-	Morioka et al (1936)
Tainan Prefecture	1,688	residents of foothills	10.5	64.5	22.4	0.	0.	Suzuki (1929)
Tainan "	5,312	" " plains	18.6	63.9	44.2	0.	0.	Suzuki (1929)
Taichu "	3,896	" " foothills	24.5	90.4	96.1	0.1	0.1	Suzuki (1929)
Taichu "	2,808	" " plains	57.6	92.8	95.2	0.1	0.3	Suzuki (1929)
Taichu "	2,522	" " coast	53.7	90.4	92.5	0.1	-	Suzuki (1929)
Taichu "	5,627	" " valleys	60.1	94.0	95.4	0.1	0.1	Suzuki (1929)
Shinchiku "	1,195	" " foothills	0.1	50.6	15.2	0.	0.	Suzuki (1929)
Shinchiku "	2,003	" " plains	0.1	51.2	12.3	0.	0.	Suzuki (1929)
Taihoku "	1,663	" " foothills	27.5	94.8	44.3	0.2	0.	Suzuki (1929)
Taihoku "	2,680	" " plains	25.3	88.5	50.7	0.	0.2	Suzuki (1929)
Taihoku "	2,129	" " coast	6.0	55.6	13.5	0.	-	Suzuki (1929)
Taihoku "	1,354	" " valleys	27.4	85.4	12.7	0.	0.	Suzuki (1929)

Trichuris trichiura. The prevalence of whipworm infection, as determined by stool examinations, is similar to that of ascariasis. Rates from 12 percent to 95 percent were recorded by Suzuki (1929). According to this investigator 52.8 percent of the entire population harbors whipworm. Taichu Prefecture has by far the greatest incidence, 93 to 96 percent. In Taihoku Prefecture the incidence varies from 12.7 percent in the valleys to 50.7 percent in the plains; along the coast it is 13.5 percent. In Tainan the rates vary from 23 percent in the valleys and foothills to 44 percent on the plains. In Shinchiku 12 to 15 percent was observed and the rate for the plains of Takao Prefecture was found to be 19.4 percent. Trichiuriasis is also common in Karenko District.

Enterobius vermicularis. This species is relatively rare with infection rates from less than one percent to seven percent according to various surveys. Suzuki (1929) found Enterobius in 0.05 percent of all fecal samples examined.

Strongyloides stercoralis. Infection rates as high as 2.4 percent have been found. In more than 39,000 examinations Suzuki (1929) found only 0.06 percent with Strongyloides.

Trichostrongylus orientalis. This parasite is relatively rare. Suzuki (1929) found only 0.02 percent of the people infected with it.

Cestodes

Taenia saginata. This tapeworm is described by Yokogawa and Morishita (1931, 1933) as common in Formosa. It can be safely assumed that most of the cases of taeniasis reported by various authors are caused by Taenia saginata. Yokogawa et al (1928) found eggs or proglottids in 10.3 percent of the stool examinations made in Shinchiku Prefecture. In more than 30,000 examinations in all parts of the island Suzuki (1929) found 0.32 percent with tapeworms.

Taenia solium. Yokogawa and Morishita (1931, 1933) state that only one case of taeniasis due to this species of cestode worm is recorded from Formosa.

Hymenolepis diminuta. Yokogawa and Wakejima (1932) described this cestode as rare among the school children of Formosa. Normally a parasite of rats there are scattered records of its occurrence in humans in Formosa.

Hymenolepis nana. As in other areas this species is more frequently found in man in Formosa than is Hymenolepis diminuta. Mayeozoka (1935) examined 4,931 aboriginal children, 1,948 Chinese children, and 739 Japanese children in Taitō Prefecture and found this very common (10-40 percent); it was noted as rare in adults.

Diphyllobothrium mansoni. This species has been recorded in man several times from Formosa. In these infections man plays the role of an accidental second intermediate host by drinking water containing infected Cyclops, a fresh-water copepod, or by the direct entry of the larva through cutaneous lesions. The resulting plerocercoid larva may develop in any part of the body. The definitive hosts are dogs, cats, and wild carnivora. Suzuki (1929) found nine cases in the foothills.

TABLE XXXIX

Prevalence of various trematode infections

according to selected surveys and investigations

Locality	Number Examined	Description	Paragonimus westermani	Metagonimus yokogawai	Fasciolopsis buski	Clonorchis sinensis	Heterophyes	Reference
			Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	
Taihoku	971	Japanese schoolchildren	0.1	0.2	-	-	-	Narihara et al (1938)
Taihoku	1,363	Chinese schoolchildren	0.2	0.	-	-	-	Narihara et al (1938)
Shinchiku Prefecture	5,150*	general population	4.5	-	-	-	-	Kinugasa (1939)
	1,434	hospitalized children	-	0.3	-	-	-	Muto (1941)
Taihoku	555	outpatients	-	7.0	-	10.6	-	Yamazaki (1925)
All Prefectures	228**	220 children						
		8 adults	-	-	1.8	-	-	Suzuki (1925)
Shinchiku Prefecture	32*	aboriginal children	18.8	-	-	-	-	Nagayoshi (1934)
Karenko District	716	general population 3 villages	-	0.6	0.	0.6	0.1	Oi (1927)
Karenko City	220	hospital patients	-	0.9	0.	3.2	-	Oi (1927)
Karenko "	40	fishermen	-	5.0	0.	0.	-	Oi (1927)
Karenko "	168	schoolchildren	-	0.6	0.	0.	-	Oi (1927)
Taihoku "	259	medical students	-	-	1.2	1.2	-	Morioka et al (1936)
Taichu Prefecture	3,896	residents of foothills	-	0.	-	2.1	-	Suzuki (1929)
Taichu "	2,808	" " plains	-	0.	-	0.6	-	Suzuki (1929)
Taichu "	5,627	" " valleys	-	0.1	-	0.3	-	Suzuki (1929)
Taihoku "	1,663	" " foothills	-	0.	-	0.	-	Suzuki (1929)
Taihoku "	2,680	" " plains	-	0.3	-	0.	-	Suzuki (1929)
Taihoku "	1,354	" " valleys	-	0.	-	3.6	-	Suzuki (1929)
Shinchiku "	1,195	" " foothills	-	0.	-	2.1	-	Suzuki (1929)
Shinchiku "	2,003	" " plains	-	0.	-	0.	-	Suzuki (1929)
Tainan "	9,095	----------	-	0.	-	0.	-	Suzuki (1929)
Takao "	4,703	----------	-	0.	-	0.	-	Suzuki (1929)

* Examined for Paragonimus only.

** Examined for Fasciolopsis only.

Raillietina (Ransomia) formosana. This species is listed as a rare human parasite in Formosa by Yokogawa and Morishita (1931, 1933).

Trematodes

Paragonimus westermani. The adult fluke is a lung parasite of man and many species of Carnivora. The first intermediate host in Formosa is apparently always a species of Melania although it is possible that snails of other genera may be involved. The second intermediate hosts are fresh-water crabs of the Eriocheir and other genera. Yokogawa and Morishita (1931, 1933) list Potamon (Geothelphusa) dehaani, Potamon (Geothelphusa) obtusipes, Eriocheir japonicus, Sesarma (Holometropus) dehaani, and Parathelphusa (Parathelphusa) sinensis as the intermediate hosts in Formosa. Potamon obtusipes is apparently the most important. In endemic areas it is 80-100 percent infected. Infection occurs by eating uncooked or improperly cooked infected crayfish. Paragonimiasis appears to be particularly prevalent in Shinchiku Prefecture. Kinugasa (1939) examined more than 5,000 individuals and found 4.5 percent infected. Nagayoshi (1934) found 18.8 percent of a small group of school children to be harboring adult Paragonimus flukes. According to Kinugasa, however, the infection is more prevalent in adults than in children. This author believes that most of the infections are contracted by eating salted crab and crayfish. Among school children in Taihoku infection rates of 0.1 to 0.2 percent have been observed.

Metagonimus yokogawai. This intestinal fluke is a parasite of man, piscivorous mammals, and some piscivorous birds such as pelicans. The first intermediate hosts are snails of the genus Melania. The cercariae, on leaving the snail intermediate hosts, encyst under the scales of the second intermediate hosts which in Formosa are several species of fresh-water fish. Infection occurs when these fish are eaten improperly cooked. Metagonimus eggs have been found in the feces in as many as seven percent of some samples of the population and Yokogawa and Morishita (1931-1933) state that from 0.7 to 4.5 percent of all Formosans are infected. However, the data of Suzuki (1929) show its incidence to be much lower. The available data show metagonimiasis to be more prevalent in Taihoku Prefecture and Karenko District than elsewhere.

Fasciolopsis buski. This is the "giant intestinal fluke" of man. The only other animal in which it occurs commonly is the hog. The molluscan intermediate hosts of this trematode include Planorbis caenosus, Segmentina nitidella, Segmentina calathus, Segmentina schmackeri, Segmentina hemisphaerula, Gyraulus sainogensis, and Hippeutis cantori. Yokogawa and Morishita (1931, 1933) state that molluscan intermediate hosts are Planorbis caenosus and Segmentina largillieri. The cercariae on emerging from the infected snail encyst on aquatic vegetation, especially on water caltrop, water chestnut, the roots of lotus, roots of water bamboo and others. Man becomes infected in eating these plants. Fasciolopsiasis occurs in Formosa wherever there are infected reservoirs (human or swine) and the molluscan intermediate hosts. Suzuki (1924) found the following rates of infection among domestic hogs: Taihoku Prefecture, 0.03 percent; Shinchiku Prefecture, one percent; Taichu Prefecture, 3.8 percent; Tainan Prefecture, 1.5 percent; and Takao Prefecture, 29.9 percent. Among humans, according to Yokogawa and Morishita (1931, 1933) it is common in the central and southern parts of the island and rare in the northern part. These authors state that in Takao Prefecture as many as 40-60 percent of the hogs are sometimes found to be infected. They

found 1.4 percent of 220 public school students of Takao infected.

Clonorchis sinensis. This is the Chinese liver fluke. It is also a parasite of the dog, cat, as well as of wild carnivores. A complete life cycle requires a minimum of three months. Among the intermediate hosts are snails of the genera Parafossarulus, Bithynia and possibly Melania. The second intermediate host may be any one of a large number of species of fresh-water fish of the families Cyprinidae, Gobiidae, Anabantidae, or Salmonidae. Yokogawa and Morishita (1931, 1933) list only Ctenopharyngodon idellus as a second intermediate host in Formosa; doubtlessly other species are involved. Infection occurs as a result of the use of improperly cooked or uncooked flesh of these fish. Clonorchiasis is widespread in Formosa and taking the island as a whole, is probably the most prevalent trematode infection. Various samples of the population have shown rates from zero to 10.6 percent. Suzuki (1929) found 3.6 percent in the valley district of Taihoku Prefecture and 2.1 percent in the foothills of Shinchiku Prefecture.

Schistosoma japonicum. This is the Asiatic blood fluke. In addition to man; dogs, cats, rats, mice, cattle, water buffaloes, and horses may serve as definitive hosts of this species. The intermediate hosts are small snails of the genera Katayama, Oncomelania, and Schistosomophora. However to date the only known vector reported from Formosa has been Katayama formosana. Infection occurs when the cercariae, after leaving the snails, penetrate the skin of any immersed portion of the body. The available information indicates that schistosomiasis is more or less restricted to one endemic area in the central part of the island around Kono. It does not assume the importance which it has in China and southern Japan.

Other trematodes of medical importance. Fasciola hepatica, a liver fluke ordinarily a parasite of ruminants, occasionally infects man. According to Yokogawa and Morishita (1931, 1933) in some places in Formosa nearly all of the cattle, goats, and water buffalo are infected. Echinostomum revolutum has been found in the feces of some Formosan natives. Yokogawa and Morishita (1931, 1933) also record a single human case of Echinoparyphium koidzumii infection. Infections with Monorchotrema taihokui and Monorchotrema taichui have been recorded in Taihoku and Taichu respectively.

CHAPTER XII

ANIMALS OF MEDICAL IMPORTANCE

The animals included in this chapter are those which are of importance as intermediate hosts, vectors, reservoirs, ectoparasites, or pests.

Culicidae (Mosquitoes)

The role of mosquitoes in the transmission of malaria, dengue, and filariasis, is discussed elsewhere in this report. Appendix B contains a checklist, a key, and systematic notes on the anopheline mosquitoes of Formosa. Appendix C contains a checklist of Culicine mosquitoes.

Tabanidae (Horse Flies)

More than forty species in six genera of Tabanidae have been recorded in Formosa. Although at least two species of the genus Chrysops are known as intermediate hosts of Loa loa in Africa, it does not appear that the Formosan species transmit the disease. Insofar as the present information goes it appears that the Formosan tabanids are important only as pests. General sources on the Tabanidae are the compilations of Shiraki (1918) and Esaki (1932).

Heleidae (Biting Midges)

Only a few genera of this large family contain species known definitely to attack man. Several species are known to occur in Formosa. Lasiohelea taiwana is very common and troublesome in the field in the north central part of Formosa. Culicoides maculatus is a very troublesome pest in the mountainous regions from May to September. Culicoides sugimotonis attacks primarily domestic birds although it may attack man also. Culicoides kagiensis, Culicoides albifascia, Culicoides duodenarius, Culicoides perigrinus, Culicoides verbosus, Culicoides oxystoma, Culicoides formosae, Culicoides indecora, and Culicoides nubecula are all reported from Formosa by Tokunaga (1937) although there is no information on their biting habits.

Flies of Medical Importance

Twenty species of the genus Sarcophaga have been reported from Formosa. Sarcophaga melanura, Sarcophaga misera, Sarcophaga harpax, Sarcophaga ruficornis, and Sarcophaga peregrina are occasionally of importance in myiasis and food contamination. Sarcophaga peregrina is a domestic species. Among the Calliphoridae two species of medical importance are known to occur in Formosa. Chrysomya megacephala breeds in human feces; it is attracted to sweets and occasionally is involved in myiasis. Calliphora paradoxa is a mechanical disseminator of disease. Chrysomya bezziana is an important species in myiasis with a wide oriental distribution; it may occur in Formosa although no actual records could be found. Eleven species of Musca are known to occur in Formosa. Of these, Musca domestica and Musca sorbens are the "houseflies". Musca crassirostris has piercing mouth parts and can penetrate thin skin and sores. Stomoxys calcitrans, the stable fly, and Stomoxys indica

are biting species and are also involved in the mechanical transmission of disease. Muscina stabulans frequently enters houses; the same is true of Ophyra chalcogaster which breeds in human feces. The above-mentioned muscoid flies are also occasionally involved in wound or intestinal myiasis. Piophila casei may occur in Formosa. This species is frequently involved in human intestinal myiasis. Infection usually occurs through ham, bacon, cheese, or other contaminated food.

Flebotomus

Flebotomus is the only genus of medical importance in the Psychodidae (sandflies). In northern China and Manchukuo Flebotomus is suspected in the transmission of kala-azar, a leishmaniasis. Because of the proximity of Formosa to the endemic areas in Asia its psychodid fauna may warrant some attention. Actually Flebotomus was unknown until 1939 when Tokunaga (1939) found there a species similar to Flebotomus decipiens.

Simuliidae (Black Flies)

Although at least three species of Eusimulium and two species of Simulium are known elsewhere as vectors of onchocerciasis the medical importance of this family in Formosa, on the basis of the available information, seems to be restricted to that of pests. The best general source of information on the Formosan species is Shiraki's monograph (1935). Seven species are recorded from Formosa.

Hemiptera (True bugs) of Medical Importance

Both species of bedbugs, Cimex lectularius and Cimex hemipterus, are known to occur in Formosa. The former is more apt to be encountered in the port cities. Conorhinus rubrofasciatus, an assassin bug, is common in Formosa. It is often attracted by artificial light and invades houses. Its bite is very painful. The nymphs, when molting in houses, often get into ears causing considerable trouble.

Anopleura (Lice)

Esaki reports the body louse, Pediculus humanus corporis; head louse, Pediculus humanus capitis; and pubic louse, Phthirius pubis to be present in Formosa. Precise data are not available on the prevalence of infestations by these species although they are reported to be common.

Siphonaptera (Fleas)

The following list of fleas is compiled from the papers of Sugimoto (1933, 1933) and Omori (1938).

1. Pulex irritans L., 1758
   Hosts: Man, dogs, cats, rabbits, monkeys, rats, fowls.
   Not common in Formosa.

2. Xenopsylla cheopis (Rothschild), 1903
   Hosts: Rattus rattus rufescens, Mus musculus L., Crocidura murina L., Rattus rattus rattus L., Rattus norvegicus, and man.
   Recorded only from Taihoku in Formosa.

3. Ctenocephalis canis (Curtis), 1826
   Hosts: Dogs, man, cats, fox, fowls.
   Recorded only from Taihoku in Formosa.

4. Ctenocephalis felis (Bouche), 1835
   Hosts: Cats, dogs, man.
   Found throughout Formosa.

5. Ctenocephalis musculi Sugimoto, 1933
   Hosts: Rattus rattus rufescens. Also collected from chicken nest.
   Recorded only from Taihoku.

6. Leptopsylla segnis (Schönherr), 1811
   Hosts: Rattus rattus rufescens, Rattus norvegicus, Sorex araneus, Crocidura leucodon, Apodemus sylvaticus, and also from the nest of Eliomys quercinus.

7. Nosopsyllus fasciatus (Bosc), 1801
   Hosts: Rattus rattus rufescens, Rattus losea, Crocidura murina, Callosciurus erythraeus roberti in Formosa. Reported elsewhere from man.

8. Ceratophyllus anisus Rothschild, 1907
   Hosts: Rats, man.

9. Ceratophyllus sauteri Rothschild, 1914
   Hosts: ?

10. Ischnopsylla tateishii Sugimoto, 1933
    Hosts: Myotis watasei
    Recorded from Taihoku, Formosa.

Acarina (Mites and Ticks)

Several species of mites of medical importance have been recorded from Formosa. Without a doubt the most important from a medical standpoint is Trombicula akamushi whose larva is the vector of tsutsugamushi disease both on the main island and in the Bōko Islands. Trombicula hirsti, also known to infest man, has been reported from Formosa.

Sugimoto (1940) has prepared a list of tyroglyphid mites known to occur in Formosa. Those known to infest man are as follows:

1. Aleurobius farinae de Geer, 1778
   Hosts: Birds, man.
   Recorded in Formosa from Taihoku and Karenko.

2. Glyciphagus domesticus de Geer, 1778
   Hosts: Man, domestic fowl
   Recorded in Formosa only from Taihoku.

3. Carpoglyphus taiwanensis Sugimoto, 1937
   Hosts: Human intestine.
   Recorded from Taihoku only.

Among the tarsonemid mites, at least two species of medical importance have been reported. Nanpio (1938) has described infections by Nephrophagus sanguinalis and Tyrophagus sanguinalis. These are rare endoparasites of the urinary tract of man.

Among the sarcoptid mites no definite information concerning Sarcoptes scabiei could be found except a single report that scabies is common.

Liponyssus nagayoi, a parasitid mite similar to Liponyssus bacoti is apparently quite common in Formosa especially in Taihoku. It is primarily a parasite of rats although in dwellings it frequently attacks man and as such is a pest of considerable importance. The bite causes severe itching. The suggestion has been made that Liponyssus bacoti may serve as a vector of endemic typhus and perhaps the same suggestion should apply to the Formosan species. In Formosa Liponyssus nagayoi is most numerous before and after the rainy season. The number decreases in fall and the mites almost disappear during the winter.

Ticks

Tick-borne diseases of humans apparently have not been reported from Formosa. Furthermore, there is no information to indicate that this group is of any importance as pests. However, because of the possibility of encountering tick-borne diseases a list of ticks known to occur in Formosa has been compiled in Appendix F.

Leeches

Two species of leeches of medical importance, Haemadipsa zeylanica, and Dinobdella ferox, are recorded from Formosa by Yokogawa and Morishita (1931-1933). Haemodipsa zeylanica is known elsewhere as a blood-sucking pest of considerable importance. It is said to occur in the highlands of Formosa. The only records of Dinobdella ferox are from Taichu Prefecture.

Mollusca and Crustacea of Medical Importance

Various species of snails are important as essential intermediate hosts of human Trematoda. Completion of the life cycle of these parasites is impossible unless the proper species of snails are present. In general the taxonomy of snails is difficult; all identifications made in the field should be checked by a gastropod specialist. The lists of intermediate

hosts in Yokogawa and Morishita (1931, 1933) indicate that much investigation on the molluscan intermediate hosts in Formosa needs to be done. All of these intermediate hosts are fresh-water mollusks, living in streams, ditches, pools, or lakes. Practically all are shallow-water forms, frequenting the margins of these bodies of water. Some even are amphibious, i.e., they may crawl out upon the wet land margins of the water. In sun-exposed places they may seek the shade of the aquatic vegetation.

Most of the species are small. To gather the smaller forms it may become necessary to sift some of the mud on the water's edge; a fly screen mesh will be fine enough. Or, one may take a burlap sack and sew it to a hoop and use this for scraping up mud and vegetable detritus, washing the finer silt through the sack and examining the residue in the bag for mollusks.

The living mollusks can be placed in glass jars; fruit jars will answer. These should not be placed in direct sunlight, but should have ample light. If they prove infected, the cercariae will, when they reach the proper stage of development, escape from the mollusks and can readily be seen as minute free-swimming animals when one holds the jar up against the light.

When it is desired to have identification made or confirmed by a gastropod expert, the material should be sent to the U. S. Naval Medical Center, Bethesda, Maryland, Attention: Curator of Mollusks, U. S. National Museum. Material for such identification should be preserved in 70 percent alcohol. The amount of alcohol should be ten times the bulk of the specimens. Locality data and collecting dates are essential. Notes on possible roles as intermediate hosts are desirable.

Certain species of fresh-water Crustacea are also important as intermediate hosts of human helminths. Cyclops and perhaps other closely related genera of copepods serve as intermediate hosts of Diphyllobothrium whereas species of crayfish of the genera Eriocheir, Sesarma, Potamon, and Parathelphusa are intermediate hosts of Paragonimus westermani in Formosa. Since there are no keys available for the identification of these groups in Formosa it is recommended that when it is desired that identification be made or verified that the material be sent to the U. S. Naval Medical Center, Bethesda, Maryland, Attention: U. S. National Museum. Large crustaceans should be killed in 30-40 percent alcohol preferably and preserved in 70 percent. The 70 percent alcohol should be changed after the first day. After a week or ten days, they can, if necessary, be removed and packed in air-tight containers for shipping in order to save space, providing the time of shipping is not too long. Microcrustacea such as Cyclops should be preserved in vials with five percent formalin or 95 percent alcohol.

Fish of Medical Importance

The problem of poisonous fish in Formosa is actually no different than in other tropical areas bordering the Pacific Ocean since most of the species are widespread in their distribution. In general, cases of fish poisoning are apparently infrequent in Formosa although there are records of cases in the literature from time to time.

All fishes with poisonous flesh belong to the Plectognathi. These fish lack the ordinary scales characteristic of bass, trout, etc. Instead they are covered with bristles or spiney scales, strong sharp thorns, or spines, or encased in a bony box-like covering. Some are naked, i.e., with no scales or spines. In this group are the fish** commonly referred to as swell or puffer fishes, porcupines, burr fishes, cow fishes, trunk fishes, box fishes, thorn fishes, etc. These are primarily species of coral reefs and rarely occur in the open sea. The poison in the flesh of the puffers and porcupine fishes is an alkaloid and is therefore not destroyed by cooking. It is commonly experienced that those in breeding condition are most poisonous. There is much disagreement among the natives as to which species are poisonous. It is possible that in many cases poisoning has been due to toxins produced by bacterial action due to improper handling and preparation.

Venomous fish (fish with poisonous spines) also occur in the waters of Formosa. The most important species belong to the scorpion family** (Scorpaenidae) and are commonly known as scorpion fish; warty lump fishes or spiney toad fishes (Synanceia); zebra or tiger fishes; or stinging fishes.

The next most dangerous venomous fishes are the sting rays. These occur in shallow water, lagoons, estuaries, etc. They usually lie on the bottom concealed in the mud or sand where it is very easy to step on them. When this occurs, the tail whips upward driving its spine into the leg of the victim. There are records of these spines actually being driven into the bones of the feet or the legs. Some catfish have pectoral fin spines equipped with poison glands. The poison produced is not particularly toxic but there is danger of secondary infection in the wound produced by the spines.

Fish as Intermediate Hosts of Human Trematoda

Certain species of fresh-water fish, primarily of the families Cyprinidae, Gobiidae, Anabantidae,and Salmonidae, are the second intermediate hosts in the life cycles of Metagonimus yokogawai and Clonorchis sinensis. However, the species of fish involved cannot in most cases be discussed with any degree of completeness. Because of this and the highly technical nature of the identification of fish it is suggested that the services of an expert be obtained in identifying suspected species. Caution must always be exercised to insure the thorough cooking of all fresh-water fish used as food.

If it is desirable to collect and preserve specimens for identification, the following points should be observed. If possible, the fish should be placed alive in a mixture of one part of commercial formalin and nine parts of water. This solution is of sufficient strength to preserve small fish up to five inches in length, in about three days, but larger specimens should be left in it for a

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*Much of the information in this section is from notes supplied by Dr. Leonard P. Schultz, Curator of Fishes, U. S. National Museum.

**There are illustrations of these fish in "Survival on Land and Sea," Publications Branch, Office of Naval Intelligence, 1943.

greater length of time, depending on their size. All specimens over three inches in length should have a small slit made in the side of their abdomen, or they should be injected with the formalin preservative. Very large fish, a foot or more in length, should have the formalin not only injected into their abdomen, but about every two inches in the muscle tissue as well, and left in the formalin solution from five to seven days, or more. After that time, if it is desired, they can be transferred to water, and the formalin washed out for one or two days, and then placed in seventy five percent alcohol. One precaution should be observed, never to crowd the fish in the containers. There should be plenty of excess space and they should never be placed in the container like sardines are packed in a can. If it is desired to leave the specimens in formalin indefinitely, they may be transferred to a weaker solution, made up as follows: One part formalin to fifteen or eighteen parts of water, to which has been added two teaspoonsful of borax to each gallon of preservative. This weaker formalin solution is usually of sufficient strength to preserve the fish indefinitely if the container is closed tightly. Always fill the containers full of liquid.

If formalin is unavailable alcohol can be used. Specimens should be placed, while still alive if possible, into thirty-five percent alcohol and in about six hours they should be placed in seventy-five percent alcohol. If the specimens are at all crowded, the alcohol should be poured off and fresh seventy-five percent alcohol added the next day. If specimens become soft, then another change of alcohol should be made, using seventy-five percent again. In general, formalin preservation is best at the start and should be used instead of alcoholic preservation because the formalin hardens the specimens. However, after the fish have been in formalin a week, they should be transferred to seventy-five percent alcohol, after thoroughly washing the formalin out, because the acid in the formalin has a tendency to soften the bones unless it is neutralized.

Labels with essential data (date, locality, kind of water, collector) should be placed in each jar package. A durable paper (linen) should be used when the label is placed in the preserving fluid. If for security reasons, data cannot be included it should be given a number and the same number placed with the specimens. Fish, after they are thoroughly preserved (usually 1-2 weeks), may be wrapped for shipment in the following manner: Place the small fish in a stack (like wood is piled), with their heads outward, so that the tails are protected, and then wrap them in cloth, with the ends secured firmly, tied up with a string or sewed. Be sure and protect all the fins when wrapping fish for shipment. All containers should be completely filled with packages of fish, or the excess space filled with excelsior, or dry grass. Do not use paper; it softens and dissolves in the liquid and does not fill the spaces. After the container is completely filled, then most or all of the excess liquid may be poured off, leaving the contents of the container wet. Be sure the container is sealed to prevent evaporation. In the case of metal cans, the top should be soldered on. Shipment may be made by mail or express or other means.

In the event formalin or alcohol is not available, fishes may be preserved in salt. The fish should first be soaked in a saturated brine solution and, when thoroughly impregnated, they should then be packed in dry salt for shipment. As in the case of other methods of preservation, the abdominal cavities should be opened to allow the salt solution to enter freely. It may be necessary in the case

of fishes that feed on vegetation, to open the intestinal tract and remove the vegetable matter accumulated therein.

To secure identification the specimens should be sent to the U. S. Naval Medical Center, Bethesda, Maryland, Attention: Curator of Fishes, U. S. National Museum.

Poisonous Snakes

The tropical fauna of Formosa is herpetologically very rich. Of the 97 species and subspecies of the Japanese snakes listed in Maki's monograph (1931) 60 were found in Formosa. Except the sea snakes (Hydridae) and some of the colubrids and amblycephalids which, though poisonous to some extent, are so unobtrusive in their habits that they are rarely in conflict with man, 14 are poisonous. There are annually three to four hundred snake-bite cases on the island with an average mortality rate of about 6.64 percent. There are more cases of snake bite each year than of tsutsugamushi disease.

The following is a brief discussion of the more important species. For the key to the species and statistical data see Appendix D.

1. Trimeresurus gramineus (Shaw)

Maki (1931) recognized three subspecies of this species from Formosa: formosensis Maki, stejnegeri (Schmidt), and kodairai Maki. (See the key for their separation.) The subspecies formosensis is found in southern Formosa, stejnegeri in northern Formosa and kodairai in Makazayazaya and Arisan areas. However, in the literature all the cases caused by these subspecies were accredited to T. gramineus (Shaw).

As a group these subspecies are the most common poisonous snakes in Formosa. When alive they are dark green above and yellowish beneath. They are gregarious and live among the leaves on trees, feeding on insects and other small animals. Because of its protective coloration the forest workers are often not aware of its presence before it attacks. 47.35 percent of the total cases were caused by this group. However, since their poison gland is small, the mortality is very low (0.90 percent). Their venom is hemotoxic.

2. Trimeresurus mucrosquamatus (Cantor)

This is a very fierce and well known poisonous snake in Formosa. When alive it is brown above with a series of irregular transverse dark brown spots which are black rimmed and very narrowly yellow-edged. It grows on the average to a length of about 1,000 mm. It is found both in mountains and plains, preying upon rats and other small animals. It frequently invades houses after its prey. It is aggressive in nature and readily attacks people and domestic animals. Its venom is strong and hemotoxic. About 25.96 percent of the total snake-bites were caused by this species. The mortality rate is 8.38 percent. This species is distributed all over the island and found on hills and in woods.

3. Agkistrodon acutus (Guenther)

This is the most venomous snake of all the species. It is found in the

mountains and woods of central and southern Formosa, especially in the aboriginal areas. It is commonly known as the "one hundred steps snake", a name indicating that its bite will cause the death of the victim within one hundred steps. Its venom is hemotoxic and weaker than that of T. mucrosquamatus. However, the amount of the venom discharged in a strike is so large that it usually causes death within a few hours.

This is not a very large species, though it generally attains a length of over 1,000 mm., and is very thick. Its color in life is greyish brown above with a series of large inverted V-shaped dark-brown, black-edged markings on each side close to the median dorsal line. The underside is yellowish and spotted with black blotches. Its head is dark brown with the rostrum distinctly produced upward into an appendage which is characteristic of this species.

Due to its sedentary habits the number of cases caused by this species is rather low (1.90 percent of the total cases), but the mortality rate is high, 24.17 percent, the highest of all the species.

This species has been collected from Hori, Koshun, Hoppo, Taichu, Shinko, and Karenko.

4. Naja naja atra (Cantor)

This is a well known poisonous species in southern Asia and is also common in Formosa. When alive the body is brownish black dorsally and laterally with a pair of characteristic white-rimmed "spectacles" on the upper neck and about 15 very narrow yellowish transverse lines on the body. The belly is black and strongly shiny. When disturbed it takes a position ready for the strike by erecting the anterior part of its body and distending its neck, accompanied with a strange hissing noise.

It is a violent and aggressive species with strong neurotoxic venom. As this species usually attacks with warning, its victims compose only 4.16 percent of the total cases. However, its mortality rate is as high as 14.67 percent.

This species is very common in southern part of Formosa but not so common in the northern part. It has been collected from South Cape, Koshun, Kiirun, Hori, Tansui, Hoppo and Tainan.

5. Bungarus multicinctus Blyth

This is one of the most common poisonous snakes in Formosa. It is frequently found along small streams, among grasses and in the neighborhood of dwellings, preying upon mice, frogs, fish or other snakes, and often gets into houses, after its prey. It is not found in mountains without residents. This species is not aggressive and will run away from people. But it will attack when it is stepped on. The percentage of the total snake-bites is only 7.07 but the mortality rate of this species is as high as 23.04 percent, next only to that of A. acutus. Its venom is very strong and neurotoxic.

Its body above is barred with black and white and beneath white and more or less clouded with blackish brown.

This species, unlike other poisonous species, has a small rounded head instead of an enlarged triangular head. Because of this characteristic together with its unstriking coloration it is often mistaken as non-poisonous.

This species has been collected from Taihoku, Koshun, Hori, Hoppo and Tainan.

6. Vipera russellii formosensis Maki

This species has been known in Japanese literature as Coluber russellii siamensis (Smith). Maki (1931) distinguished it from Siamese species by the absence of the additional elongated series of small spots on either side of the body interposed between the usually three longitudinal rows of the large ones, and the presence of the additional series of spots interposed between the black rings of the dorsal series or between the lateral series. It is found along the eastern and western coasts and at the base of the mountains of southern Formosa, living in the sand and protected by means of its protective coloration.

About 0.36 percent of the total cases were caused by this species. Its mortality rate is 2.22 percent.

This species has been collected from Choshu, Heito, Daito, Karenko.

7. Calliophis macclellandii formosensis (Thompson)

This species has been known in Japanese literature as well as in other literature as Calliophis swinhoei van Denburgh. Maki (1931) called it C. macclellandii formosensis (Thompson) on the basis that "the name given by Thompson to this species has the priority of about six months over that given by Denburgh."

This is a species of minor importance and only 3 cases of snake bite by it (0.02 percent of the total cases) have been reported. It is found in central and southern parts of Formosa but rarely in the northern part. Its body is reddish brown above and crossed by regular, narrow, light-edged black bars. It is distinguished from the typical macclellandii from the Asiatic mainland by a greater number of ventrals, subcaudals, and transverse bands.

It has been collected from Shinchiku, Kosempo, Suishario, Toen, Taihoku, and Choshu.

Mammals of Medical Importance

Kuroda (1938) has listed fifteen species and subspecies of murine rodents in Formosa (see Appendix E). There are four domestic rats: Rattus rattus rattus, Rattus rattus alexandrinus, Rattus norvegicus, and Rattus rattus rufescens. The last is apparently very common. Rattus coxinga, Rattus losea, and Rattus rattus rufescens have been regarded as of epidemiological importance in tsutsugamushi disease. The domestic mouse is Mus musculus taiwanus. Numerous mammals, as well as birds, serve as hosts of the larvae of Trombicula akamushi, the tsutsugamushi disease vector. These relationships are discussed in the chapter on tsutsugamushi disease.

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APPENDIX A

POPULATION DATA
MEDICAL PERSONNEL AND FACILITIES ACCORDING TO PREFECTURE

TABLE I

Population According to Prefectures

Year	Taihoku	Sinchiku	Taichu	Tainan	Takao	Taitō	Karenko	Bōko	Total
1920	751,677	575,496	796,960	959,229	507,324	49,602	60,838	56,712	3,757,838
1925	838,979	622,643	895,693	1,044,838	559,500	54,778	69,156	61,875	414,746
1930	939,021	681,552	1,031,508	1,181,596	637,902	59,335	85,458	62,721	4,679,093
1935	1,052,527	734,272	1,185,532	1,351,140	742,682	70,143	111,745	67,601	5,315,642
1938	1,124,721	781,075	1,281,816	1,456,818	821,753	81,840	129,728	69,208	5,746,959

TABLE II

Distribution of Population Groups of Formosa and the Bōko Islands

Prefectures	Total	Formosan Chinese	Aborigines Subdued	Aborigines Wild	Japanese	Koreans	Chinese	Other Foreigners
Taihoku	998103	856757	2512	6346	110304	335	20574	133
Sinchiku	709478	694399	2702	13336	13084	71	1922	2
Taichu	1096925	1061116	7164	15175	31322	178	4294	15
Tainan	1241597	1194367	8903	1648	40408	136	6652	34
Takao	673267	636119	25538	30294	31051	168	5924	5
Taito	62685	57080	3294	41668	4903	25	675	2
Karenko	95366	79375	5908	36349	14029	46	1916	-
Bōko	65012	62473	-	-	2479	-	60	-
Total	4932433	4641686	56021	144816	247580	959	42017	191

TABLE III

Prefectural distribution of the hospitals, physicians, and other medical workers in Formosa in 1932

Prefectures & Districts	Hospitals				Physicians				Gen.	Dentists		Pharmacists		Midwives	Drug Manu.	Druggists	No. of population per 1 physician
	Gov't.	Pub.	Pri.	Tot.	Gov't.	Pub.	Pri.	Tot.	Pract.	Gov't.	Pri.	Gov't.	Pri.				
Taihoku	5	6	47	58	94	41	180	315	45	6	70	19	28	281	16	425	2745
Shinchiku	1	1	9	11	9	34	71	114	115	-	13	4	3	98	1	342	3098
Taichu	1	2	31	34	20	42	219	281	68	-	54	9	13	217	-	700	3143
Tainan	2	4	48	54	43	44	313	400	53	2	66	12	13	593	2	719	2741
Takao	2	3	15	20	20	32	150	202	24	-	38	6	10	290	-	365	2979
Taitō	1	-	-	1	3	16	3	22	-	-	3	2	-	9	-	14	2849
Karenko	1	2	14	17	12	17	23	52	-	-	8	2	-	21	1	47	1834
Bōko	1	-	-	1	4	7	6	17	-	-	3	2	-	15	-	37	3824
Total	14	18	164	196	205	233	965	1403	305	8	255	56	67	1524	20	2649	

APPENDIX B

ANOPHELINE MOSQUITOES

Checklist of Anopheline Mosquitoes in Formosa

The following list follows closely the reports of Morishita (1936, 1936).

1. Anopheles (Anopheles) insulaeflorum Swellengrebel and Swellengrebel-de Graaf, 1920.
2. Anopheles (Anopheles) aitkenii bengalensis Puri, 1930.
3. Anopheles (Anopheles) lindesaii Giles, 1900.
4. Anopheles (Anopheles) gigas baileyi Edwards, 1929.
5. Anopheles (Anopheles) hyrcanus sinensis Wiedemann, 1828.
6. Anopheles (Myzomyia) kochi Doenitz, 1901.
7. Anopheles (Myzomyia) tessellatus Theobald, 1901.
8. Anopheles (Myzomyia) minimus Theobald, 1901.
9. Anopheles (Myzomyia) jeyporiensis candidiensis Koidzumi, 1924.
10. Anopheles (Myzomyia) indefinitus (Ludlow), 1904.
11. Anopheles (Myzomyia) ludlowi Theobald, 1903.
12. Anopheles (Myzomyia) maculipalpis splendidus Koidzumi, 1920.
13. Anopheles (Myzomyia) maculatus Theobald, 1901.
14. Anopheles (Myzomyia) annularis van der Wulp, 1884.

In addition to these an undescribed subspecies of Anopheles leucosphyrus has been reported from Osato, Karenko District.

Systematic Notes On Formosan Anopheline Mosquitoes

These notes are compiled with some additions and changes from Morishita (1936, 1936). The references cited are Morishita's and are not included in the bibliography of this report. Morishita (1932) has compared Formosan material with specimens from other areas making his work standard from the standpoint of nomenclature.

1. Anopheles (Anopheles) insulaeflorum Swellengrebel et Swellengrebel de Graaf, 1920.
   Unclassified larva No. 1 Swellengrebel et Swellengrebel de Graaf, Med. v. d. Burg. Geneesk, D. in Ned. Ind. VI, p. 23, 1919.
   Stethomyia aitkeni var. insulaeflorum Swell. et. Swell. de Graaf, Med. v. d. Burg. Geneesk, D. in Ned. Ind. addendum p. 2, 1919, IX, 1920.
   Anopheles insulaeflorum Swell. et Swell. de Graaf, Puri, Ind. Jour. Med. Res. XVIII, p. 954, 1930.
   Anopheles (Anopheles) insulaeflorum Swell. et Swell. de Graaf, Morishita, Taiwan Igakkai Zassi, XXXV, p. 586, 1936.

   Localities: Tainan Prefecture: Chuho, Insui.
   Shinchiku Prefecture: Kakuhansan.
   Karenko District: Taishō.
   (According to Hatori, Koidzumi, and Anazawa, specimens of spotless winged Anopheles were also collected from Taisoku and Shokei of Taihoku Prefecture and Shinnenshō and Suisha of Taichu Prefecture. However; since Morishita has not seen their specimens identifications cannot be given. They might belong either to this species or to the following species.)

   Distribution: India; Ceylon; Malay P.; Java; New Guinea; Lesser Sunda; Moluccas; Natuna Is.; Philippines.

This is one of the so-called spotless species of Anopheles. Hatori (1923) was the first one to report the occurrence of spotless Anopheles from Formosa. The species was not certain and was called A. aitkeni James. Hatori had only one female but the male genitalia are necessary for specific identification. It is now clear that there are two species of spotless Anopheles in Formosa. It cannot be certain which of the two species Hatori's specimen belongs. Morishita (1929) first collected the larvae of insulaeflorum from Insui of Tainan Prefecture. Adults were reared from the larvae collected in the same locality by Kiyomidzu. Specimens were also collected from Chuho of Tainan Prefecture, Kakuhansan of Shinchiku Prefecture, and Taishō of Karenko District. Both larvae and adults were compared with those from Malay archipelago by Morishita and the species was verified. Specimens from Shōkei of Taihoku Prefecture were also reported by Koidzumi 1927.

2. Anopheles (Anopheles) aitkeni bengalensis Puri, 1930.
Anopheles aitkeni var. bengalensis Puri, Ind. Jour. Med. Res., XVII, p. 953, 1930.
Anopheles (Anopheles) aitkeni var. bengalensis Puri, Morishita, Taiwan Igakkai Zassi, XXXV, p. 584, 1936.

Localities: Tainan Prefecture: Chuho, Insui.
Taichu Prefecture: Suisha, Inagosha. (Probably also Shinnenshō.)
Karenko District: Taishō.

Distribution: China; Malay P.; India; Philippines.

This form also has unspotted wings. The occurrence of this subspecies in Formosa was first ascertained by Kiyomidzu who reared some adults from the brownish larvae collected in Insui of Tainan Prefecture. Before that time Anazawa and Noda (1926) collected in Shinnenshō of Taichu Prefecture some colored larvae which, according to Hatori, were different from aitkeni James by the following characters: The inner clypeals with 4 apical branches and the outer clypeals also branched. It is suspected that they should belong to this subspecies but this cannot be verified without examining the specimens. Later Morishita collected some specimens of the same kind from Suisha and Inagosha of Taichu Prefecture, and identified them as Puri's bengalensis.

3. Anopheles (Anopheles) lindesaii Giles, 1900.
Anopheles lindesaii Giles, Handb. Mosq. ed. 1, p. 166, 1900.
Anopheles pleccaw Koidzumi, 5th Report of the Research Bureau of Taiwan Government, p. 34, 1920.
Anopheles pleccau Koidzumi, Trans. 5th Congr. F.E.A.T.M. (1923), p. 97, 1924; Dōbutsu-gaku Zassi (Zoological Magazine), XXXVII, p. 330, 1925; Taiwan Igakkai Zassi, No. 271, p. 1013, 1927.
Anopheles japonicus Yamada (pro parte), Eiseigaku Densen-byogaku Zassi (Jl. of Hygiene and Infectious Diseases), XIII, p. 639, 1918; Sci. Rep. Gov. Inst. Inf. Dis. III, p. 219, 1924.
Anopheles lindesaii var. pleccau Koidzumi, Christophers, Rec. Mal. Surv. India, II, p. 321, 1931.
Anopheles (Anopheles) lindesaii Giles, Koidzumi and Morishita, Taiwan Igakkai Zassi, XXXI, p. 286, 1932.

Localities: Taichu Prefecture: Banchi (aboriginal settlement), Suisha, Shinnenshō.
Tainan Prefecture: Banchi, Arisan.
Taihoku Prefecture: Tojō, Tainan-ō, Rokuhi-bansha.
Shinchiku Prefecture: Babutoku.
Karenko District: Horin, Taishō.

Distribution: China; India.

The larvae and adults of this species were first collected in Musha of Taichu Prefecture by Koidzumi (1917). It was considered as a new species similar to Giles' lindesaii but the larvae were distinctly different. He named it A. pleccaw (afterwards he used pleccau but the original of 1920

was pleccaw). The record of the larvae of lindesaii was incomplete. The description of James and Liston was different from the specimens from Formosa. According to Strickland lindesaii and pleccaw were very closely related but again Strickland's description was not clear. So whether pleccaw was a good species or a variety of lindesaii remained a question (1925). Christophers (1924) after examining the specimens left in the British Museum by Koidzumi considered them as lindesaii. Morishita (1927) examined a number of adults of lindesaii from India and compared the larvae from Formosa and the detailed description by Puri (1931) and found no substantial difference between lindesaii and pleccaw in either adults or larvae. Christophers (1931) from the Formosan female specimens discovered that the dark scales on the dorsal side of the base of the posterior femora were somewhat different from those of lindesaii. However, after careful examination of both Indian specimens and Formosan specimens Morishita found that this character was exeedingly variable. Morishita believes that the Formosan species is identical with lindesaii.

Yamada (1918) described A. japonicus from Hokkaido and considered that that it was also a Formosan species. However his A. japonicus of Formosa was distinct from japonicus of Hokkaido. Morishita agrees with Christophers (1931) who considered japonicus as a variety of lindesaii.

4. Anopheles (Anopheles) gigas baileyi Edwards, 1929.
   Anopheles gigas var. baileyi Edwards, Bull. Ent. Res. XX, p. 323, 1929.
   Anopheles from Arisan Toyozumi, Taiwan Igakkai Zassi, XXXIV, p. 36, 1935.
   Anopheles (Anopheles) gigas var. baileyi Edwards, Morishita, Taiwan Igakkai Zassi, XXXV, p. 888, 1936.

   Localities: Arisan; Shinchiku Prefecture; Babutoku.

   Distribution: China; Burma; India.

This subspecies was recently collected by Toyozumi (1935) from Arisan and temporarily called Arisan Anopheles. Morishita received some specimens collected by Morida (1931) from Babutoku of Shinchiku Prefecture and suspected them as the same as the Arisan specimens. Some of Toyozumi's specimens, both larvae and adults, were identified by Morishita as the above subspecies. However, this determination was principally based on the characters of the adults. Christophers (1931) recognized 4 varities in the gigas group in addition to the typical gigas from the adults. As to the characters of the larvae Christophers (1933) cited Strickland's (1925) description which is simple. Very recently Rice, Datta et Bell (1936) published detailed description of the larvae of var. baileyi. According to this description it seems that this variety is very similar to var. simlensis. The only difference is that the lateral hairs of the 5th abdominal segment are simple in the former but branched in the latter. This was not mentioned in Strickland's work. The specimens from Formosa have simple hairs, so that Morishita's determination is also correct for the larvae.

5. Anopheles (Anopheles) hyrcanus sinensis Wiedemann, 1828.
Anopheles sinensis Wiedemann, Auss. zweifl. Ins. I, p. 547, 1828; Koidzumi, Taiwan Igakkai Zassi, No. 271, p. 1003, 1927.
Anopheles yesoensis Tsuzuki, Saikingaku Zassi, No. 71, p. 1, 1901; no. 75, p. 93, 1902 (A. jesoensis).
Anopheles vulgare Hatori, Kan Ho (official report), No. 5534, 1901.
Anopheles pseudopictus of Kinoshita (nec. Grassi), Anopheline mosquitoes, 2nd Report, p. 6, 1903; Tokyo Igakkai Zassi, XVII, p. 753, 1903.
Myzorhynchus sinensis Wiedemann, Hatori, Taiwan Igakkai Zassi, No. 114 & 115, p. 279, 1912.
Anopheles hyrcanus var. sinensis Wiedemann, Yamada, Sci. Rep. Gov. Inst. Inf. Dis. III, p. 223, 1924.
Anopheles (Anopheles) hyrcanus var. sinensis Wiedemann, Christophers, Ind. Med. Res. Mem. No. 3, p. 28, 1924; Koidzumi & Morishita, Taiwan Igakkai Zassi, XXXI, p. 284, 1932.

Localities: Entire Island.

Distribution: China; French Indo-China; Malay P.; Burma; India; Borneo; Java; Sumatra; Philippines; Manchuria; Korea; Japan.

Miyashima first identified this mosquito as Anopheles sinensis and considered it the same as the form of Japan proper.

6. Anopheles (Myzomyia) kochi Dönitz, 1901.
Anopheles kochi Dönitz, Insektenborse XVIII, p. 34, 1901; Kinoshita, Anopheline Mosquitoes, 3rd Report, p. 107, 1904.
Anopheles ocellatus Theobald, Mono. Cul. I, p. 174, 1901.
Cellia flava Ludlow, Canad. Ent. XL, p. 32, 1908.
Christophersia halli James, Paludism, No. 1, p. 33, 1910.
Myzomyia kochi (Dönitz), Yamada, Sci. Rep. Gov. Inst. Inf. Div. IV, P. 489, 1925.

Locality: Kiirun (only 1 female was captured in 1903 and there was no record afterwards).

Distribution: China; French Indo-China; Siam; Malay P.; Burma; India; Sumatra; Java; Borneo; Philippines; Lesser Sunda.

Since Kinoshima collected 1 female specimen of this species from Kiirun in May 1903, there has been no other record from this island. It is not known whether the specimen was a native of Formosa or imported from elsewhere. Since this species is distributed in much of the orient it is possible that it was brought in to Kiirun which is an open port. Furthermore there may also be question regarding Kinoshita's determination. However, it is different from all the known Formosan species and Kinoshita, after comparing it with all the related species found that it was most similar to kochi and "provisionally" called it such.

7. Anopheles (Myzomyia) tessellatus Theobald, 1901.
Anopheles tessellatus Theobald, Mono. Cul. I, p. 175, 1901.
Anopheles tessellatus Theobald, Koidzumi, Trans. 5th Congr. F.E.A.T.M., (1923), p. 100, 1924.
Anopheles formosae Hatori, Kan Ho (official report), No. 5534, p. 275, 1901.
Anopheles deceptor Dönitz, Zeit. Hyg. XLI, p. 60, 1902.
Anopheles formosaensis, II, var. Tsuzuki, Saikingaku Zassi, No. 75, p. 101, 1902.
Anopheles annulipes of Kinoshita (nec Walker), Anopheline Mosquitoes, 3rd Report, p. 81, 1904.
Myzomyia punctulata of Hatori (nec Dönitz), Taiwan Igakkai Zassi, No. 90, p. 837, 1910.
Dactylomyia ceylonica Newstead et Carter, Ann. Trop. Med. Par. IV, p. 377, 1910.
Nyssomyzomyia punctulata of Hatori (nec Dönitz), Taiwan Igakkai Zassi, Nos. 114 & 115, 1912.
Myzomyia thorntonii Ludlow, Canad. Ent. XXXVI, p. 69, 1904.
Anopheles thorntonii Ludlow, Koidzumi, Dobutsugaku Zassi (Zoological Magazine), XXIX, p. 137, 1917.
Anopheles kinoshitai Koidzumi, Dōbutsugaku Zassi, XXIX, p. 133, 1917.
Anopheles taiwanensis Koidzumi, 8th Report of the Research Bureau of the Taiwan Government, p. 20, 1920.
Anopheles (Myzomyia) tessellatus Theobald, Koidzumi and Morishita, Taiwan Igakkai Zassi, XXXI, p. 287, 1932.

Localities: Entire Island.

Distribution: China; French Indo-China; Siam; Malay P.; Burma; India; Ceylon; Sumatra; Java; Borneo; New Guinea; Philippines; Lesser Sunda; Moluccas.

Since Hatori's A. formosae (1902) this species has also been called A. formosaensis, II variety, Tsuzuki, A. punctulatus Dönitz, A. annulipes Walker, A. thorntonii Ludlow, A. kinoshitai Koidzumi and A. taiwanensis Koidzumi until Koidzumi (1920) identified it as this species.

8. Anopheles (Myzomyia) minimus Theobald, 1901.
Anopheles minimus Theobald, Mono. Cul. I, p. 186, 1901; Koidzumi, 8th Report of the Research Bureau of Taiwan Government, p. 38, 1920.
Anopheles from Tamsui Hatori, Kan Ho (Official Report), No. 5534, p. 275, 1901.
Anopheles christophersi Theobald, Proc. Roy. Soc. LXIX, p. 378, 1902.
Anopheles formosaensis I, Tsuzuki, Sankin-gaku Zassi, No. 75, p. 97, 1902.
Anopheles sp. a. Kinoshita, Anopheline mosquitoes, 2nd Reports, p. 20, 1908.
Anopheles listoni of Kinoshita (nec. Liston), Anopheline mosquitoes, 3rd Report, p. 89, 1904.

Myzomyia listoni of Hatori (nec. Liston), Taiwan Igakkai Zassi, No. 114 & 115, p. 279, 1912.
Myzomyia christophersi var. alboapicalis Theobald, Mono. Cul. V, p. 25, 1910.
Myzomyia minima (Theobald), Yamada, Sci. Rep. Gov. Inst. Inf. Dis. IV, p. 447, 1925.
Anopheles (Myzomyia) minimus Theobald, Koidzumi and Morishita, Taiwan Igakkai Zassi, XXXI, p. 285, 1932.

Localities: Entire Island.

Distribution: China; French Indo-China; Siam; Malay P.; Burma; India; Ceylon; Sumatra; Java; Celebes; Lesser Sunda.

This species was first called Anopheles from Tamsui by Hatori (1901). A. formosaensis I of Tsuzuki and A. listoni Liston of Kinoshita and Hatori are also this species according to Koidzumi (1920).

9. Anopheles (Myzomyia) jeyporiensis candidiensis Koidzumi, 1924.
Anopheles candidiensis Koidzumi, Trans. 5th Congr. F.E.A.T.M. (1923), p. 98, 1924; Dōbutsugaku Zassi, XXXVII, p. 343, 1925; Taiwan Igakkai Zassi, No. 271, p. 1027, 1927.
Myzomyia jeyporiensis var. candidiensis Koidzumi, Yamada, Sci. Rep. Gov. Inst. Inf. Dis. IV, p. 490, 1925.
Anopheles aconitus var. tonkinensis Toumanoff, C. R. Soc. Biol. CVII, p. 375, 1931.
Anopheles (Myzomyia) jeyporiensis var. candidiensis Koidzumi & Morishita, Taiwan Igakkai Zassi, XXXI, p. 285, 1932; Morishita, Taiwan Igakkai Zassi, XXXV, p. 892, 1936.

Localities: Taichu Prefecture: Suisha, Suirikō, Tamarowan.

Distribution: China; French Indo-China; Burma; India.

This species was collected from Suisha of Taichu 1922 and 1923 and named A. candidiensis by Koidzumi. He compared it with minimus, aconitus, culicifacies, and jeyporiensis and pointed out its difference from the first three species but stated that the description of the larva of jeyporiensis by James and Liston was too brief and no comparison could be made. Yamada (1925), basing upon Koidzumi's description, considered that it was not substantially different from jeyporiensis and called it a variety of jeyporiensis by which he meant a variant form rather than a subspecies. Morishita examined a number of adults of jeyporiensis from India and found no distinct difference from the Formosan specimens. But in the larvae there is rather constant difference of thoracic palmate hairs according to the description of Puri and Choudhurg. He agreed with Yamada that it is a variety of jeyporiensis but did not consider it only as a variant form (1932). A. jeyporiensis var. candidiensis was also found in Indo-China, Hongkong, and China since then. Christophers (1933) in the type jeyporiensis of Cochin-China found a different proportion of the apical white and preapical dark of the palpi and maintained that the adults of candidiensis and jeyporiensis are not

altogether similar. Later Morishita compared the specimens from India with some specimens of Cochin China and Hongkong, in the collection of Singapore Medical College and confirmed Christophers' idea, i. e. candidiensis is not only a variant form of jeyporiensis but a valid variety. He maintains his statement (1932) that there was no constant difference between the adult of jeyporiensis and that of var. candidiensis after examining the Kasauli collection.

10. Anopheles (Myzomyia) indefinitus (Ludlow, 1904)
Myzomyia rosii var. indefinita Ludlow, Canad. Ent. XXXVI, p. 297, 1904.
Anopheles formosaensis, II, Tsuzuki, Saigingaku Zassi, No. 75, p. 98, 1902.
Anopheles formosaensis Tsuzuki, Dönitz, Zeit. Hyg. XLIII, p. 234, 1902.
Anopheles sp. b. Kinoshita, Anopheline Mosquitoes, 2nd Report, p. 25, 1903.
Anopheles rossi of Kinoshita (nec Giles) Anopheline Mosquitoes, 3rd Report, p. 97, 1904; of Hatori (nec Giles), Taiwan Igakkai Zassi, No. 90, p. 832, 1910.
Myzomyia (Nyssomyzomyia) rossi of Hatori (nec Giles), Taiwan Igakkai Zassi, No. 114 and 115, p. 279, 1912.
Nyssomyzomyia rossi of Hatori (nec Giles), Nisshin Igaku, III, p. 37, 1913.
Myzomyia formosaensis, II (Tsuzuki), Yamada, Sci. Rep. Gov. Inst. Inf. Dis., IV, p. 454, 1925.
Anopheles vagus of Yamada (nec. Dönitz), as synonym of Myzomyia formosaensis, II, Sci. Rep. Gov. Inst. Inf. Dis. IV, p. 454, 1925.
Anopheles subpictus var. indefinitus (Ludlow), King, Phil. Jour. Sci., XLVII, p. 325, 1932.
Anopheles (Myzomyia) indefinitus (Ludlow), Morishita, Taiwan Igakkai Zassi, XXXIV, p. 558, 1935.

Localities: Central and southern parts of Formosa (south of Taichu Prefecture); Taito District; Bōko Islands.

Distribution: Philippines.

This is the most confused species from Formosa as far as its nomenclature is concerned. It was first reported by Tsuzuki (1902) from this island by the name Anopheles formosaensis II. Hatori (1901) collected some specimens which probably belonged to the same species. Dönitz (1902, 1903) received some specimens from Tsuzuki and considered them first as a variety of vagus and then a variety of rossii (now subpictus) and used the name formosaensis Tsuzuki. Kinoshita (1904) and Hatori (1910-12) called it rossii. Christophers (1924) examined the balsam specimens in the British Museum sent by Tsuzuki and considered it close to vagus. Yamada (1925) studied the specimens collected from this island and maintained that they were different from rossii and should come between vagus and rossii var. indefinitus. He considered that these three should be of same species and adopted the name formosaensis II of Tsuzuki.

These different opinions were due on one hand to the meagre descriptions of the different species and on the other hand to the lack of larval specimens. Tsuzuki (1907) illustrated his species but according to Morishita his illustration cannot be relied upon. In 1932 King pointed out the distinction of vagus and rossii (=subpictus). The Philippine species which had been considered as vagus was not the typical vagus but a variety called limosus. The adult specimens of Formosa are the same as indefinitus and the larvae collected by Shimizu (1932) and Morishita (1934) are also identical with that of indefinitus. Therefore this species is not rossii or vagus as identified by Hatori and Yamada respectively.

As to the name of the species Tsuzuki (1902) first used A. formosaensis II which was prior to Ludlow's name. But Tsuzuki's name does not comply with binomial system (formosaensis I= minimus) and therefore indefinitus should be the correct name. Ludlow and King considered it as a variety of subpictus but Morishita considers it as sufficient to be an independent species.

11. Anopheles (Myzomyia) ludlowii Theobald, 1903
    Myzomyia ludlowii Theobald, Mono. Cul. III, p. 42, 1903.
    Anopheles sp. aus Taito, Hatori, Taiwan Igakkai Zassi, No. 90, p. 833, 1910.
    Myzomyia (Nyssomyzomyia) ludlowi Theobald, Hatori, Taiwan Igakkai Zassi, No. 114 and 115, p. 279, 1912.
    Anopheles ludlowi var. formosaensis Koidzumi, Dōbutsugaku Zassi, XXIX, p. 354, 1917.
    Anopheles hatorii sp. nov. (?) Koidzumi, 8th Report of the Research Bureau of the Taiwan Government, p. 24, 1920.
    Anopheles hatorii Koidzumi, Trans. 5th Congr. F.E.A.T.M. (1923), p. 101, 1924; Dōbutsugaku Zassi, XXXVII, p. 361, 1925; Taiwan Igakkai Zassi, No. 271, p. 1047, 1927.
    Myzomyia hatorii Koidzumi, Yamada, Sci. Rep. Gov. Inst. Inf. Dis. IV, p. 459, 1925.
    Anopheles (Myzomyia) ludlowii Theobald, Christophers, Ind. Med. Res. Mem. No. 3, p. 59, 1924; Koidzumi and Morishita, Taiwan Igakkai Zassi, XXXI, p. 286, 1932 (ludlowi).

    Localities: Central, Southern and Eastern parts of Formosa (including Eastern part of Taihoku Prefecture).

    Distribution: Philippines; Ceram (Moluccas). There is a recent report of this species being taken in Hainan Island.

In 1910 Hatori collected this species from Taito and provisionally called it Anopheles of Taito. Later (1912) he identified it as Myzomyia ludlowii Theobald. Koidzumi considered it different from ludlowii and first (1917) called it ludlowii var. formosaensis and then (1920-23) named it A. hatorii as an independent species. Christophers (1924) considered it similar to ludlowii, but Yamada (1925) agreed with Koidzumi. Rodenwaldt (1926) examined Formosan material and called it ludlowii. This confusion was due to the fact that specimens from India, Malay, Dutch East Indies and

Philippines have been all called ludlowii but the true ludlowii has only been found from the original locality in the Philippines and Ceram. Those from other localities were considered different and called ludlowii var. sundaicus by Rodenwaldt. The species of Formosa is different from sundaicus but similar to the species from Philippines. Anopheles sundaicus (Rodenwaldt) is now regarded as a distinct species.

12. Anopheles (Myzomyia) maculatus Theobald, 1901.

Anopheles maculatus Theobald, Mono. Cul. I, p. 171, 1901; Hanabusa, Taiwan Igakkai Zassi, No. 8, p. 1, 1903; Kinoshita, Anopheline Mosquitoes, 3rd Report, p. 7, 1904; Hatori, Taiwan Igakkai Zassi, No. 90, p. 832, 1910; Koidzumi, Dōbutsugaku Zassi, XXIX, p. 351, 1917; Trans. 5th Congr. F.E.A.T.M. (1923), p. 93, 1924; Dōbutsugaku Zassi, XXXVII, p. 351, 1925; Taiwan Igakkai Zassi, No. 271, p. 1035, 1927.

Nyssorhynchus pseudowillmori Theobald, Mono. Cul. V, p. 65, 1910.

Nyssorhynchus maculatus Theobald, Hatori, Taiwan Igakkai Zassi, No. 114 and 115, p. 279, 1912.

Nyssorhynchus willmori James, Theobald, Mono. Cul. III, p. 100, 1903.

Neocellia willmori James, Hatori, Taiwan Igakkai Zassi, No. 119, p. 876, 1912; No. 124, p. 122, 1913.

Anopheles maculatus var. nov. (?) Koidzumi, 8th Report of the Research Bureau of Taiwan Government, p. 19, 1920.

Anopheles maculatus var. dravidicus Christophers, Ind. Jour. Med. Res., XII, p. 297, 1924.

Myzomyia hanabusai Yamada, Sci. Rep. Gov. Inst. Inf. Dis. IV, p. 471, 1925.

Anopheles (Myzomyia) maculatus Theobald, Koidzumi and Morishita, Taiwan Igakkai Zassi, XXXI, p. 285, 1932.

Localities: Entire Island.

Distribution: China; French Indo-China; Siam; Malay P.; Burma; India; Ceylon; Sumatra; Java; Borneo; Celebes; Philippines; Lesser Sunda; Natuna Islands.

In 1903 Hanabusa first reported this species from Kiirun. But the specimens from this island are somewhat different from the original description of maculatus in the distribution of the scales on the dorsal surface of abdominal segments. In the original description the scales are only found on VI to VIII segments while in the Formosan specimens they extend much further to the anterior segments. For this reason Hatori (1912) considered it as willmori. Koidzumi also considered it different from maculatus. Yamada (1925) named it hanabusai. Morishita examined a number of specimens from India and found that the distribution of the scales on the abdominal segments are quite variable. The Formosan species maculatus and willmori is not an independent species but should be included in maculatus.

13. Anopheles (Myzomyia) maculipalpis splendidus Koidzumi, 1920.
Anopheles splendidus Koidzumi, 8th Report of the Research Bureau of Taiwan Government, p. 23, 1920; Dōbutsugaku Zassi, XXXVII, p. 357, 1925; Taiwan Igakkai Zassi, No. 271, p. 1043, 1927.
Nyssorhynchus maculipalpis var. indiensis Theobald, Mono. Cul. III, p. 99, 1903.
Anopheles maculipalpis of James et Liston (nec Giles), Mono. Anoph. Mosq. India ed. 1, p. 95, 1904.
Nyssorhynchus indiensis Theobald, Mono. Cul. III, p. 98, 1907.
Nyssorhynchus maculipalpis of Hatori (nec Giles), Taiwan Igakkai Zassi, No. 119, p. 871, 1912.
Myzomyia indiensis Theobald, Yamada, Sci. Rep. Gov. Inst. Inf. Dis. IV, p. 46, 1925.
Anopheles (Myzomyia) maculipalpis var. splendidus Koidzumi, Koidzumi and Morishita, Taiwan Igakkai Zassi, XXXI, p. 287, 1932.

Localities: Entire Island.

Distribution: China; Indo-China; Siam; Burma; India.

Hatori (1912) first captured this variety from Hokuto of Taihoku Prefecture and called it Nyssorhynchus maculipalpis James et Liston. Giles (1902) reported maculipalpis from Africa which is similar to an Indian form named indiensis as a variety of it by Theobald (1903). Koidzumi (1920) considered that the Formosan form as a new species and named it splendidus. Yamada (1925) maintained that the Formosan form was identical with the Indian form which is a different species from African species and called it Myzomyia indiensis (Theobald). Morishita's opinion is as follows: The Formosan form is identical with the Indian form and not a different species but a variety of maculipalpis of Africa. Since the name of indiensis is preoccupied, as Christophers pointed out, splendidus should be used as the name of the variety. Many authors regard splendidus as a species rather than a subspecies or variety of maculipalpis.

14. Anopheles (Myzomyia) annularis van der Wulp, 1884.
Anopheles annularis van der Wulp, Notes from Leyden Museum, VI, p. 249, 1884.
Anopheles fuliginosus Giles, Handb. ed. 1, p. 160, 1900; Kinoshita, Anopheline Mosquitoes, 3rd Report, p. 100, 1904; Hatori, Taiwan Igakkai Zassi, No. 90, p. 833, 1910; Koidzumi, 8th Report of the Research Bureau of Taiwan Government, p. 22, 1920; Dōbutsugaku Zassi, XXXVII, p. 367, 1925; Taiwan Igakkai Zassi, No. 271, p. 1053, 1927.
Anopheles leucopus Dönitz, Insektenbörse, XVIII, p. 37, 1901; Hanabusa, Taiwan Igakkai Zassi, No. 8, p. 5, 1903; Kinoshita, Anopheline Mosquitoes, 2nd Report, p. 29, 1903; Tokyo Igakkai Zassi, XVII, p. 770, 1903.
Anopheles leucopus var. Tsuzuki, Zool. Jahrb. Syst. XXV, p. 552, 1907.
Nyssorhynchus fuliginosus Giles, Hatori, Taiwan Igakkai Zassi, No. 114 and 115, p. 833, 1912.

Myzomyia fuliginosa (Giles) Yamada, Sci. Rep. Gov. Inst. Inf. Dis. IV, p. 464, 1925.
Anopheles (Myzomyia) fuliginosus Giles, Koidzumi and Morishita, Taiwan Igakkai Zassi, XXXI, p. 286, 1932.
Anopheles (Myzomyia) annularis van der Wulp, Morishita, Dōbutsugaku Zassi, XXXV, p. 891, 1936.

Localities: Entire Island (but rare in northern part).

Distribution: China; French Indo-China; Siam; Malay P.; Borneo; Lesser Sunda; India; Burma; Philippines.

The first record of this species from this island was by Hanabusa (1903) who collected 1 specimen from Kutsusechi of Taihoku Prefecture, and called it A. leucopus Dönitz. In 1904 Kinoshita identified it as fuliginosus annularis van der Wulp, 1884, and fuliginosus Giles are identical and the name annularis has the priority.

Matumoto and Motoura (1939) reported the occurrence of an additional species from Osato in Karenko District. It was identified by Morishita as similar to Anopheles leucosphyrus and possibly a new variety of this species. The authors gave a detailed description of both the adult and the larva.

In addition an undescribed subspecies of Anopheles leucosphyrus has been reported from Osato in Karenko District.

Keys to the Anopheline Mosquitoes of Formosa

These keys are translations of those of Morishita (1932, 1936). The keys for the females and larvae have been tested with material in the U. S. National Museum and appear to be reliable.

Key to Adult Females

1. Wings spotless.....*insulaeflorum* or *aitkenii bengalensis*
   Wings spotted..... 2

2. Last segment of posterior legs with white..... 10
   Last segment of posterior legs without white..... 3

3. Costal vein with not more than two pale spots..... 4
   Costal vein with 4 or more pale spots..... 5

4. Costal vein with one apical spot; apical half of posterior femora with distinct white band.....*lindesaii*
   Costal vein with subcostal and an apical spot; femora without white band.....*hyrcanus sinensis*

5. Femora and tibiae scattered with small spots..... 9
   Femora and tibiae without small spots..... 6

6. Posterior femora with a large subapical dorsal pale spot.....
   .....*gigas baileyi*
   Posterior femora without pale spot..... 7

7. Anterior tarsal segments with distinct pale ring at base....*indefinitus*
   Anterior tarsal segments without pale ring at base..... 8

8. Apical pale band of palpi 1 to 2 times as broad as the second one, legs without pale rings at joints.....*minimus*
   Apical pale band of palpi 4 to 5 times as broad as the second one, apices of 1st to 3rd tarsal segments with narrow pale bands.....*jeyporiensis candidiensis*

9. Palpi with four pale bands, apical half of proboscis yellowish brown.....*tessellatus*
   Palpi with 3 pale bands, proboscis with only the labella yellowish brown.....*ludlowii*

10. Posterior legs with apex of 2nd tarsal segment and all other tarsal segments beyond it pale..... 11
    Posterior tarsal segments not entirely pale but with 3 pale bands at the joints of the segments..... 12

11. Femora and tibiae with many small spots .....*maculipalpis splendidus*
    Femora and tibiae without small spots.....*annularis*

12. Ventral abdominal segments with groups of black scales, palpi with 4 pale bands, apical half of proboscis yellowish brown.....kochi
Ventral abdominal segments without groups of dark scales, palpi generally with 3 pale bands, proboscis with only labella yellowish brown.....maculatus

Anopheles kochi has been reported only once from Formosa.

Key to the Fourth Instar Larvae

1. Inner clypeal hairs placed close together medianly..... 2
Inner clypeal hairs distantly separated from each other..... 6

2. Inner clypeal hairs with 2-6 branches.....aitkeni bengalensis
Inner clypeal hairs simple..... 3

3. Outer clypeal hairs fan-shaped.....hyrcanus sinensis
Outer clypeal hairs generally simple, rarely with 2-3 branches.. 4

4. Dorsal hairs of 1st abdominal segment palmate, composing 9-12 leaflets, posterior clypeals with 2-6 branches... insulaeflorum
Dorsal hairs of 1st abdominal segment not palmate but with 3-4 branches..... 5

5. Posterior clypeal hairs simple, inner prothoracic hairs generally with 8 or more branches, dorsal hairs of meta-thorax palmate, lateral hairs of 5th abdominal segment generally with 3 branches.....lindesaii
Posterior clypeal hairs generally simple, sometimes with 2-3 branches, inner prothoracic hairs generally with 5 or less branches, dorsal hairs of meta-thorax not palmate, lateral hairs of 5th abdominal segment simple.....gigas baileyi

6. Tergal plate of abdominal segments conspicuously large..... 7
Tergal plate of abdominal segments small..... 8

7. All clypeal hairs simple.....minimus
Both outer and inner clypeal hairs with many fine branches.....
.....jeyporiensis candidiensis

8. Thorax with palmate hairs..... 9
Thorax without palmate hairs..... 11

9. Outer clypeal hairs pinnately branched.....annularis
Outer clypeal hairs simple and short..... 10

10. Dorsal hairs of 1st and 2nd abdominal segments palmate.....kochi
Dorsal hairs of 1st and 2nd abdominal segments not palmate.....tessellatus

11. All clypeal hairs simple..... 12
Clypeal hairs generally finely branched..... 13

12. Dorsal hairs of 1st and 2nd abdominal segments palmate, the former with 4-9 (generally 6-7) spindle-shaped leaflets and the latter with 10-12 flame-shaped leaflets.....indefinitus
Dorsal hairs of 1st abdominal segment not palmate, but composed of 4-5 fine branches, those of 2nd segment palmate and with 8-9 leaflets.....ludlowii

13. Both inner and outer clypeal hairs with few fine branches, inner occipital hairs generally simple, outer occipital hairs with 2-4 branches.....maculatus
Both inner and outer clypeal hairs with many fine conspicuous branches, inner occipital hairs generally branched, outer occipital hairs with 6-9 branches.....maculipalpis splendidus

Key to the Eggs of the Common Species of Anopheles in Formosa

1. Both floats and frills present..... 2
Frills incomplete, floats absent.....ludlowii

2. Floats touching margins of dorsal surface..... 3
Floats not touching margins of dorsal surface..... 5

3. Frill entire.....hyrcanus sinensis
Frill not entire..... 4

4. Dorsal surface divided into three portions, frill at both end portions, roundly protruding towards inside.....maculatus
Dorsal surface not divided into three portions.....annularis

5. Dorsal surface broad, occupying about 2/3 of the entire width.....indefinitus
Dorsal surface narrow, occupying less than 1/3 of the entire width..... 6

6. Floats narrow, ventral surface with whitish polygonal markings.....tessellatus
Floats conspicuously broad.....minimus

APPENDIX C

CHECKLIST OF THE CULICINE MOSQUITOES OF FORMOSA

Checklist of the Culicine Mosquitoes of Formosa

This checklist is prepared principally from the compilation of Esaki (1932) although some more recent records have been added. The nomenclature including the subgeneric classifications are according to Edwards (1932).

Culex (Culex) bitaeniorhynchus Giles, 1901
Culex (Culex) whitmorei Giles, 1904
Culex (Culex) sitiens Wiedemann, 1828
Culex (Culex) tritaeniorhynchus Giles, 1901
Culex (Culex) vishnui Theobald, 1901
Culex (Culex) quinquefasciatus Say, 1823
Culex (Culex) mimeticus Noé, 1899
Culex (Culiciomyia) pallidothorax Theobald, 1905
Culex (Lophoceratomyia) rubithoracis Leicester, 1908
Culex (Lutzia) vorax Edwards, 1924
Mansonia (Mansonioides) uniformis Leicester, 1908
Armigeres (Armigeres) obturbans (Walker), 1860
Armigeres (Leicesteria) annulitarsis Leicester, 1908
Aëdes (Stegomyia) horishensis Yamada, 1920
Aëdes (Stegomyia) albopictus (Skuse), 1895
Aëdes (Stegomyia) aegypti (L.), 1762
Aëdes (Finlaya) albolateralis (Theobald), 1908
Aëdes (Finlaya) hatorii Yamada, 1921
Aëdes (Finlaya) togoi (Theobald), 1907
Aëdes (Finlaya) formosensis Yamada, 1917
Aëdes (Ochlerotatus) vigilax (Skuse), 1889
Megharinus manicatus Edwards, 1921
Megharinus aurifluus Edwards, 1921
Tripteroides (tripterisides) bambusa, 1917

Hypothetical List

The mosquitoes in this list are included because of questionable records or because of widespread oriental distribution which would indicate their possible occurrence in Formosa.

Culex (Culex) gelidus Theobald, 1901
Culex (Culex) sinensis Theobald, 1903
Mansonia (Mansonioides) crassipes van der Wulp, 1892
Megharinus aurifluus formosensis Ogasawara*
Harpagomyia genurostris (Leicester), 1908

*The original description of this subspecies has not been examined; it is therefore placed in the hypothetical list.

APPENDIX D

POISONOUS SNAKES

Checklist of Terrestrial Poisonus Snakes

of Formosa

Family Elapidae

Bungarus multicinctus Blyth, 1861

Naja naja atra (Cantor), 1842

Calliophis macclellandii formosensis (Thompson), 1912

Hemibungarus sauteri sauteri (Steindachner), 1913

Hemibungarus sauteri hatorii (Takahashi), 1930

Family Viperidae

Vipera russellii formosensis Maki, 1931

Family Crotalidae

Agkistrodon acutus (Guenther), 1888

Agkistrodon halys blomhoffii (Boie), 1826

Trimeresurus gramineus stejnegeri (Schmidt), 1925

Trimeresurus gramineus formosensis Maki, 1931

Trimeresurus gramineus kodairai Maki, 1931

Trimeresurus gracilis Oshima, 1920

Trimeresurus monticola orientalis (Schmidt), 1927

Trimeresurus mucrosquamatus (Cantor), 1839

1. Cases of snake-bites and deaths therefrom in Formosa in 1904-1938 (from To, 1941)

Year	Population	T. mucro-squamatus		T. gramineus		A. acutus		Naja naja atra		B. multi-cinctus		V. russellii formo-sensis		C. macclel-landii formo-sensis		Unknown		Total		Inci-dence per 1000000 popula-tion	Case fata-lity
		Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths		
1905	3,123,302	92	8	124	-	-	-	19	2	11	-	-	-	-	-	23	2	269	12	86.13	4.46
1910	3,299,493	73	7	138	5	1	-	18	4	23	7	-	-	-	-	38	11	291	34	88.20	11.68
1915	3,569,842	72	4	92	2	1	-	19	1	13	3	-	-	-	-	41	6	238	16	66.67	6.72
1920	3,757,838	64	4	135	1	6	1	16	4	16	1	1	-	-	-	56	7	294	18	78.24	6.12
1925	4,147,462	92	9	168	1	9	1	12	1	17	1	2	-	-	-	57	4	357	17	86.08	4.76
1930	4,679,066	113	9	203	2	14	4	26	2	35	6	2	-	-	-	54	2	447	25	95.53	5.59
1931	4,803,976	145	4	261	4	23	7	30	6	35	9	2	-	-	-	45	4	541	34	112.62	6.28
1932	4,929,962	132	8	279	1	15	4	21	3	45	10	3	-	-	-	31	3	526	29	106.69	5.51
1933	5,060,507	92	7	220	-	13	4	18	5	28	8	1	-	-	-	45	3	417	27	82.40	6.47
1934	5,194,980	77	7	210	2	21	6	19	6	33	11	1	-	-	-	57	7	418	39	80.46	9.33
1935	5,315,642	110	4	236	2	20	5	10	2	38	16	3	-	-	-	36	6	462	35	86.91	7.58
1936	5,451,863	102	12	205	6	13	2	23	4	44	15	2	-	-	-	30	5	419	44	76.85	10.50
1937	5,609,042	102	6	212	-	14	4	20	-	56	14	2	-	-	-	30	2	436	26	77.73	5.96
1938	5,746,959	120	10	193	-	14	4	24	3	42	7	-	-	-	-	28	5	421	29	73.26	6.89
Total 1904-1938	142,388,580	3,283	275	5,987	54	240	58	593	87	894	206	45	1	3	-	1,600	158	12845	839	88.81	6.64
Annual aver-age	4,068,245.14	93.80	7.86	171.06	1.54	6.86	1.66	16.94	2.49	25.54	5.89	1.29	0.03	0.09	-	45.71	4.51	361.29	23.97		
Incidence per 1,000,000 population		23.06	1.93	42.05	0.38	1.69	0.41	4.16	0.61	6.28	1.45	0.32	0.01	0.02		11.24	1.11	88.81	5.89		
Case fatality		8.38		0.90		24.17		14.67		23.04		2.22		-		9.88		6.64			
Percent by species		25.96	32.78	47.35	6.44	1.90	6.91	4.69	10.37	7.07	24.55	0.36	0.12	0.02	-	12.65	18.83	100.00	100.00		

2. Cases of snake-bites in different prefectures of Formosa in 1919-1938 (from To, 1941):

Prefecture and district	T. mucro-squa-matus	T. grami-neus	A. acutus	Naja naja atra	B. multi-cinc-tus	V. russellii formo-sensis	Un-known	Total	Annual average	Per-cent
Taihoku	880	1,055	28	39	168	2	145	2,317	115.85	27.06
Shinchiku	305	749	28	38	103	1	162	1,386	69.30	16.19
Taichu	206	262	21	83	118	3	116	809	40.45	9.44
Tainan	135	141	4	52	69	1	84	486	24.30	5.68
Takao	345	711	55	67	83	2	130	1,395	69.75	16.29
Taito	146	662	47	57	50	4	189	1,155	57.75	13.49
Karenko	162	520	31	53	47	29	173	1,015	50.75	11.85
Total	2,181	4,100	214	389	638	42	999	8,563	428.15	100.00
Annual average	109.05	205.00	10.70	19.45	31.90	2.10	49.95	428.15		
Percent by species	25.47	47.88	2.50	4.54	7.45	0.49	11.67	100.00		

3. Seasonal distribution of the cases of snake-bites according to habitat 1921-1938 (from To, 1941):

Habitat	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	Annual average	Percent
Mountain forest	32	29	50	91	166	194	193	229	201	173	104	42	1,504	83.56	19.12
Plain	10	9	26	43	71	100	92	120	129	83	59	21	763	42.39	9.70
Rice field	15	7	27	38	66	82	106	110	83	94	61	18	707	39.28	8.99
Dry field	22	26	43	109	162	222	202	205	193	175	104	55	1,518	84.33	19.29
Roads	18	11	41	74	152	170	218	219	243	204	97	40	1,487	82.61	18.90
River	1	3	7	14	35	36	53	46	36	28	17	9	285	15.83	3.62
House	16	23	21	46	126	134	158	174	176	119	73	24	1,090	60.56	13.85
Unknown	10	7	15	27	67	69	59	87	64	55	41	13	514	28.56	6.53
Total	124	115	230	442	845	1,007	1,081	1,190	1,125	931	556	222	7,868	437.11	100.00

Key to Formosan Terrestrial Poisonous Snakes

(Systematic arrangement according to Maki, 1931)

1. Ectopterygoid bone absent; teeth in upper jaw only .. Fam. Typhlopidae*
   Ectopterygoid bone present; teeth in both jaws 2

2. Maxillary horizontal; a mental groove present or absent 3
   Maxillary vertically erectile 9

3. A mental groove present 4
   A mental groove absent ..... Fam. Amblycephalidae*

4. Anterior maxillary teeth not grooved nor perforated .. Fam. Colubridae*
   Anterior maxillary teeth grooved or perforated ..... Fam. Elapidae 5

5. Median dorsal scale row enlarged, hexagonal, subcaudals single ..... Bungarus multicinctus
   Median dorsal scale row not enlarged, subcaudals divided 6

6. Vertebrae with long ribs which enable the distention of neck; scales in 21 to 23 rows on body ..... Naja naja atra
   No elongated ribs on cervical vertebrae; scales in 13 to 15 rows on body 7

7. Two small solid teeth on maxillary behind a pair of large grooved fangs 8
   No teeth on maxillary behind a pair of fangs .....
   ..... Calliophis macclellandii formosensis

8. Dark crimson red above with three broad black longitudinal stripes; ventrals from 249 to 269 ..... Hemibungarus sauteri sauteri
   Dark crimson red above with three broad black longitudinal stripes; the lateral ones being interrupted by black cross-bands edged by narrow white markings; ventrals from 238 to 248 .....
   ..... Hemibungarus sauteri hatorii

9. Loreal pit absent ..... Fam. Viperidae
   ..... Vipera russellii formosensis
   Loreal pit present ..... Fam. Crotalidae 10

10. Head above covered with large symmetrical shields ...Genus Agkistrodon 11
    Head above covered with small scales ..... Genus Trimeresurus 12

11. Anterior subcaudals unpaired; snout ending in an upward pointed appendage; ventrals 162-168 ..... A. acutus
    All subcaudals paired; snout not turned upward; ventrals 132-156 ..... A. halys blomhoffii

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* All typhlopids are non-poisonous, some of the colubrids and amblycephalids are more or less poisonous but their habit is so inobtrusive that they are rarely in conflict with man.

12. Tail prehensile; nostril in a single nasal; color in life yellowish green, green or bluish green above 13
Tail not or but slightly prehensile; nostril between two nasals or in half divided nasal; color in life brownish, with dark brown spots 15

13. The third upper labial broadly in contact with the subocular; with a lateral whitish line on each side of body 14
The third upper labial separated from the subocular by a series of scales; no lateral line on each side of body .....
..... T. gramineus kodairai

14. With a red line below the lateral whitish line on each side of body
..... T. gramineus formosensis
Without a red line below the lateral whitish line on each side of body ..... T. gramineus steinegeri

15. The first lower labial divided; the second upper labial separated from the loreal by the prefoveal shield; scales in 17 - 21 rows around middle of body ..... T. gracilis
The first lower labial not divided; the second upper labial forming the anterior border of the loreal pit; scales in 25 - 30 rows around middle of body 16

16. Internasals in contact behind the rostral; ventrals 140 - 155; subcaudals 40 to 55; about 8 scales between supraoculars .....
..... T. monticola orientalis
Internasals separated by two or three scales behind the rostral; ventrals more than 200; subcaudals 60 to 95; scales between supraoculars 12 - 18 ..... T. mucrosquamatus

APPENDIX E

CHECKLIST OF THE MURIDAE OF FORMOSA

Checklist of the Muridae of Formosa

The following list, together with the collecting localities has been compiled from Kuroda's (1938) list of Japanese mammals. The nomenclature as used by this author has not been modified. Rodents other than the murid species have not been included since there is no evidence that any of them are of medical importance. Naturally not all of the species are listed here; however, it was thought to be desirable to present a complete checklist. The localities recorded here are those for Formosa only.

1. Microtus kikuchii Kuroda, 1920
   Localities: Collected only at altitudes over 6000 feet.

2. Eothenomys melanogaster (Milne-Edwards), ssp.?
   Localities: Arisan, Shikayōsha, Tōseigun.

3. Apodemus agrarius ningpoënsis (Swinhoe), 1870
   Localities: Baksa, Taihoku, Kagi.

4. Apodemus semotus Thomas, 1908
   Localities: Collected at higher altitudes in all parts of the island.

5. Micromys minutus Tokuda & Kano, ssp., 1937
   Localities: Tamsuy (Tamsui), Shikayōsha, Rumanoansha.

6. Rattus rattus rattus (Linnaeus), 1758
   Localities: None given.

7. Rattus rattus alexandrinus (Geoffroy), 1803
   Localities: Tamsui, Suirikō, Tainan, Riran.

8. Rattus rattus rufescens (Gray), 1837
   Localities: Common in houses throughout the island.
   Pescadores (Bōko) Islands.

9. Rattus coxinga (Swinhoe), 1864
   Localities: Collected in all parts of the island from lowlands to 8000 feet.

10. Rattus culturatus Thomas, 1917
    Localities: Collected from all parts of island at altitudes above 7000 feet.

11. Rattus losea (Swinhoe), 1870
    Localities: Tamsui, Bōryō, Bokusa.

12. Rattus norvegicus norvegicus (Erxleben), 1777
    Localities: Reported as common inside and outside of houses in Taihoku.

13. Mus musculus taiwanus Horikawa, 1929
    Localities: Reported from Taihoku, Shinchiku, and Taichu Prefectures; Karenko District; Bōko Islands.

14. Mus formosanus Kuroda, 1925
    Localities: Taihoku, Horigai.

15. Bandicota nemorivaga (Hodgson), 1836
    Localities: Probably an introduced species. Now reported from all parts of the island.

APPENDIX F

A LIST OF FORMOSAN TICKS

A List of Formosan Ticks

This list has been compiled largely from Ogura (1936) and Sugimoto (1937). It should not be regarded as a complete checklist since the literature has not been examined in its entirety. The nomenclature is, in general, that of the above authors. Notes on hosts and distribution refer to Formosa only.

1. Boophilus (Uroboophilus) annulatus australis (Fuller), 1899
   Hosts : sheep, cattle, water buffalo, goats, dogs, rabbit, man
   Records: throughout Formosa and the Loochoo Islands.

2. Boophilus (Uroboophilus) annulatus caudatus (Neumann), 1897
   Hosts : cattle, water buffalo
   Records: no localities given.

3. Boophilus (Uroboophilus) distans Minning, 1934
   Hosts : cattle, goats, sheep, water buffalo
   Records: no localities given.

4. Amblyomma testudinarium C. L. Koch, 1844
   Hosts : cattle, water buffalo, pigs, wild hogs
   Records: Taihoku (?), Taichu Prefecture, Tainan Prefecture, Takao Prefecture.

5. Amblyomma cyprium Koch and Neumann, 1899
   Hosts : turtles, cattle, water buffalo
   Records: no localities given.

6. Amblyomma formosanum Schultze, 1933
   Hosts : turtles
   Records: locality data not available.

7. Amblyomma yajimai Kishida, 1935
   Hosts : water buffalo
   Records: recorded only from Formosa.

8. Haemaphysalis formosensis Neumann, 1913
   Hosts : dogs, wild hogs, deer, bear
   Records: Taihoku Prefecture, Taitō District, Takao Prefecture.

9. Haemaphysalis flava Neumann, 1897
   Hosts: horses, wild hogs, deer, dogs, cattle
   Records: Taihoku Prefecture, Karenko District, Taitō District.

10. Haemaphysalis hystricis Supino, 1897
Hosts : dogs, deer, wild hogs, bear, etc.
Records: Taitō District, Taihoku Prefecture, Loochoo Islands.

11. Haemaphysalis inermis Birula, 1895
Hosts : deer, cattle, fox, dogs, etc.
Records: Taihoku Prefecture.

12. Haemaphysalis mishiyamai Sugimoto, 1935
Hosts : man, wild hogs, deer
Records: Taihoku Prefecture, Karenko District, Taitō District (?).

13. Haemaphysalis formosensis Neumann, 1913
Hosts : dog, wild hog
Records: no localities given.

14. Haemaphysalis birmaniae Supino, 1897
Hosts : many species of mammals
Records: no localities given.

15. Haemaphysalis bispinosa Neumann, 1897
Hosts : man, many species of birds and mammals
Records: no locality data available.

16. Rhipicephalus sanguineus Latreille, 1806
Hosts : dogs, cattle, water buffalo
Records: no locality data available.

17. Dermacentor taivanensis Sugimoto, 1935
Hosts: wild hog
Records: Taihoku Prefecture, Taichu Prefecture, Taitō District.

18. Dermacentor atrosignatus Neumann, 1906
Hosts : man, dog, water buffalo
Records: reported from Taichu Prefecture only.

19. Ixodes acutitarsus (Karsch), 1880
Hosts : dogs, cattle, man, wild hog
Records: Taitō District, Takao Prefecture.

20. Ixodes shinchikuensis Sugimoto, 1937
Hosts : dogs
Records: Formosa only, Shinchiku Prefecture (4,000 feet).

21. Ixodes taivanensis Sugimoto, 1937
Hosts : deer, dogs, cats, wild hogs
Records: Taichu Prefecture, Shinchiku Prefecture, Taihoku Prefecture.

22. Ixodes ricinus (Linnaeus), 1758
Hosts : many species of homoiothermic vertebrates including man
Records: none available; var. miyazakiensis Sugimoto, 1937, occurs on the Loochoo Islands.

23. Indocentor bellulus Schulze, 1935
Hosts : ?
Records: no specific localities given.

24. Argas persicus Oken, 1818
Hosts : domestic and wild birds, cattle, man
Records: there are no records of this species in Formosa; however, because of its cosmopolitan association with the domestic fowl its presence in Formosa is not unlikely.

A SUPPLEMENT TO THE EPIDEMIOLOGY OF DISEASES OF NAVAL IMPORTANCE IN FORMOSA

(NAVMED 266)

NAVMED 460

Bureau of Medicine and Surgery
Preventive Medicine Division
Epidemic Disease Control Section
September 13, 1944

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A SUPPLEMENT TO THE EPIDEMIOLOGY OF DISEASES OF NAVAL IMPORTANCE IN FORMOSA

Since the publication of the Epidemiology of Diseases of Naval Importance in Formosa (NavMed 266) additional information has become available. Because this information adds much to the communicable disease picture in Formosa, it was considered desirable to make it available in the form of a supplement. The sequence of this supplement follows as closely as possible that of the original manual.

Bureau of Medicine and Surgery
Preventive Medicine Division
Epidemic Disease Control Section
September 13, 1944

HOSPITALS, PHYSICIANS, AND OTHER MEDICAL WORKERS

(Chapter I)

There was a distinct increase in the medical personnel in the years preceding the outbreak of the Pacific war. The Government-General of Formosa in 1938 gave data regarding the prefectural distribution of hospitals, physicians and other medical workers (Table I).

The Domei News Agency (Domei Jiji Nenkan, 1943) reported that in 1940 there were 12 government hospitals in the principal cities. Public physicians subsidized by the government were in charge of the medical affairs in certain areas. The ratio of physicians to the population was one (1) to 2,400. The following were the statistics at the end of 1940:

Hospitals	Government	14	Physicians	2,401	Midwives	2,026
	Public	21	General Practitioners	133		
	Private	263	Dentists	466	Nurses	349

TABLE I

Prefectural Distribution of Hospitals, Physicians and Other Medical Workers in Formosa in 1938 (Taiwan Jijo, 1939)

	Taihoku	Shin-chiku	Taichu	Tainan	Takao	Taitō	Karenko	Bōko	Total
Government Hospitals	5	1	1	2	2	1	1	1	14
Public Hospitals	5	1	2	4	4	-	2	-	18
Private Hospitals	70	11	52	67	22	-	16	-	238
Physicians: Government	78	4	4	5	6	-	1	1	99
Physicians: Government Hospitals	118	11	24	49	22	5	8	4	241
Physicians: Public Hospitals	37	1	4	4	1	-	2	1	50
Physicians: Practitioners	306	107	294	387	182	7	28	10	1,321
Physicians: Public*	43	37	47	54	43	18	24	6	272
General Practitioners**	24	63	29	30	17	-	-	-	163
Dentists: Government	3	-	-	-	-	-	-	-	3
Dentists: Government Hospitals	8	-	-	2	-	-	-	-	10
Dentists: Public Hospitals	-	-	-	-	-	-	-	-	-
Dentists: Practitioner	96	32	87	99	63	3	9	5	394
Midwives	337	140	347	568	325	19	38	22	1,796
Nurses	142	-	5	16	3	-	-	4	170
Tooth Extractors (?)	1	-	-	-	-	-	-	1	2
Specialists in acupuncture	68	5	21	74	36	1	5	2	212
Specialists in using moxa cautery	72	5	21	66	26	1	5	1	197
Osteopaths	204	13	68	123	63	9	10	4	494
Masseurs	41	3	9	46	20	1	2	1	123
Stomach specialists (?)	19	-	4	10	5	1	2	-	41
Specialists in bone setting	2	-	-	2	10	1	1	-	16
Pharmacists: Government	12	2	4	5	2	1	1	1	28
Pharmacists: Government Hospitals	16	3	5	9	5	2	2	2	44
Pharmacists: Public Hospitals	6	-	-	1	1	-	2	-	10
Pharmacists: Practitioner	28	12	17	32	34	3	5	-	131
Druggists	137	24	38	90	11	8	12	4	324
Druggists (Chinese herbs)	302	236	487	542	271	11	39	29	1,917
Drug manufacturers	16	1	-	6	-	-	-	-	24
Manufacturers of patent medicine	155	99	202	299	96	6	10	9	876
Sellers of patent medicine	1,279	678	1,448	1,741	1,021	116	209	72	6,564
Medicine peddlers	928	1,028	1,773	1,962	786	20	132	43	6,672

*Public physicians are physicians subsidized by the government and placed in charge of medical affairs in certain areas.

**General practitioners are those persons in the private practice of medicine whose training and professional standing are somewhat below that of the physician practitioners.

MALARIA

(Chapter II)

There were some studies done on malaria in Formosa in the later thirties but most of them were on its control and remedies. No statistics are available except the 3,782 deaths (2,007 males and 1,775 females) reported by the Department of Overseas Affairs in 1935 (Tomuku Tokei, 1937). Results of blood examinations for Plasmodia in Formosa from 1934 to 1938 are given in Table II.

TABLE II

Result of Blood Examinations (Taiwan Jiji, 1939)

Year	Number of Places Examined	Number of Persons Examined	Number of Malaria Carriers	Percent of Carriers
1934	164	2,618,668	72,307	2.76
1935	169	2,559,399	78,909	3.08
1936	187	2,771,841	83,991	3.03
1937	186	2,811,820	85,575	3.04
1938	190	3,273,543	107,246	3.26

Miyabara (1937) reported that 958 of the 1,600 population on Botel Tobago were examined and 634 (66.2 percent) were found to have enlarged spleen and 153 (16 percent) were found to harbor Plasmodia. Maruyama (1935) found that 36.8 percent of the Yami population on Botel Tobago had splenomegaly and that the splenomegaly index among the children below 15 years of age was as high as 60-70 percent. Omori (1937) recorded three (3) species of Anopheles from this island, viz., sinensis, minimus and maculatus.

The relative prevalence of the three (3) species of Plasmodium vivax: malariae: falciparum in Formosa was 46:9:45 according to Hatori and Kinoshita and 43:9:48 according to the Sanitary Division of the Police Bureau of the Formosa Government (1935). However, Miyabara (1937) found that in Botel Tobago 41 percent were vivax, 35 percent were malaria and 24 percent were falciparum. This situation indicates that P. malariae is important in Botel Tobago though it is not so in the main island.

RICKETTSIOSES

(Chapter V)

Two-Week Fever. As early as 1908, Horiuchi et al reported from Taihoku 29 cases of an unknown fever which according to these workers was similar to typhoid fever but could be differentiated by serum reaction. In 1911 Kato reported two (2) cases of typhus-like fever from Kagi region (Aisan). Cases of more or less the same nature were also reported from Karenko, Takao, Taitō, and Bōko under various names, such as "unknown fever", "sporadic typhus", "mild type typhus" and "two-week fever". It is not possible to determine whether or not all the reported cases were the same disease. However, the so-called two-week fever as described by the later workers is widespread on the island.

Shimokawa and Gabe (1940) made clinical studies of 147 cases (117 males and 30 females) in the Laboratory of Internal Medicine, Medical College, Taihoku Imperial University, and reported that headache was the most common initial symptom with anorexia and fatigue ranking next. Most of the cases had chills but only a few were accompanied with shivering. Among other symptoms there were insomnia, backache, sore throat, diarrhoea, muscular pain, nausea and vomiting. The duration of the fever is from seven (7) to 19 days and 121 cases had the fever for 12-17 days, averaging 14.136 ± 0.193 days. One hundred and one cases had a temperature of 39.1-40.0°C. with an average of 39.438 ± 0.436° C.

According to Kaku (1940) the Rickettsia from the patients of the two-week fever reacted positively only with proteus strains OX19 and HX19 but negatively with both strains X2 and XK.

Kyu (1934, 1937) made extensive studies on the transmission of the disease. Rats were collected from the endemic areas in Taihoku for experimental investigations and various blood sucking insects were tested. He concluded that in Formosa the natural carriers of the organism responsible for the disease are Rattus rattus rufescens and Rattus norvegicus both of which are common on the island. Of the blood sucking insects which live on these rats, the rat fleas, Xenopsylla cheopis and Ctenocephalus felis, are the most easily infected and are undoubtedly the main agents in the transmission of the virus not only among the rats, but also from rat to man. Leptosylla musculi is probably rarely capable of transmitting the virus from rat to rat but not from rat to man. The body louse, Pediculus humanus corporis, may be infected but with difficulty. This may account for the situation that the disease is not prevalent among the aborigines where this louse is mostly found and is comparatively frequent among people who do not harbor this parasite.

ENTERIC DISEASES

(Chapter VII)

Diarrhoea and Enteritis. Twelve thousand eight hundred and seventy eight (12,878) deaths due to diarrhoea and enteritis in 1935 were reported by the Department of Overseas Affairs of Japan (Tomuku Tokei, 1937); 6,483 were males and 6,395 were females.

Typhoid Fever and Paratyphoid Fever. The official report of the Formosa Government (Taiwan Sotokufuho, 1940-1941) gives the following figures for the incidence of typhoid fever and paratyphoid fever in Formosa in 1940 and 1941:

	1940 Cases	1941 (Jan.-July) Cases	Deaths
Typhoid Fever	2066	1005	185
Paratyphoid Fever	114	52	14

The prefectural and seasonal distribution of the two diseases is shown in the following tables:

TABLE III

Prefectural Distribution of Typhoid Fever in Formosa from May 1940 to April 1941

		Taihoko	Shinchiku	Taichu	Tainan	Takao	Taitō	Karenko	Bōko	Total
1940	May	51	3	11	33	50	-	4	4	156
	June	95	6	14	39	47	-	7	2	210
	July	128	14	26	31	46	-	10	1	256
	Aug.	151	10	30	33	48	-	14	2	288
	Sept.	79	8	25	36	44	1	7	1	201
	Oct.	106	12	23	35	47	-	-	-	223
	Nov.	93	11	15	26	39	-	4	-	188
	Dec.	95	4	9	20	34	-	10	-	172
1941	Jan.	57	2	20	7	33	-	4	3	126
	Feb.	38	-	4	10	37	-	3	-	92
	Mar.	31	2	11	22	25	-	5	1	97
	Apr.	31	2	9	19	44	-	5	-	110
Total		955	74	197	311	494	1	73	14	2,119

TABLE IV

Prefectural Distribution of Paratyphoid Fever in Formosa
from May 1940 to April 1940

	Taihoku	Shinchiku	Taichu	Tainan	Takao	Taitō	Karenko	Bōko	Total
1940 May	6	-	-	1	1	-	-	1	9
June	11	1	-	1	2	-	-	-	15
July	12	1	-	1	2	-	-	-	16
Aug.	17	-	-	-	-	-	-	-	17
Sept.	8	-	1	1	1	-	-	1	12
Oct.	8	-	-	-	1	-	-	-	9
Nov.	5	-	-	-	1	-	-	1	7
Dec.	9	-	-	-	-	-	-	-	9
1941 Jan.	3	-	-	-	1	-	-	-	4
Feb.	3	-	-	-	2	-	-	-	5
Mar.	4	-	-	1	4	-	-	-	9
Apr.	1	-	-	-	2	-	-	-	3
Total	87	2	1	5	17	-	-	3	115

Ri (1937) reported an epidemic of typhoid fever in Taihoku City in 1936. About 90 cases were admitted to the Pediatrics Department of Taihoku Hospital, with 14 deaths (15.6 percent).

In Shinchiku Prefecture 239 cases of typhoid fever occurred from 1932 to 1937 (Kinugasa 1938). According to Kō (1938) 1,108 patients were admitted to the Taichu Hospital within a period of three (3) years from 1934 to 1936. One hundred eighty two (182) cases (16.4 percent) were infantile typhoid fever; 141 Japanese and 41 Formosans.

Asahi and Aida (1937) gave the following statistics for typhoid fever in Taichu City from 1927 to 1936:

TABLE V

Cases and Deaths of Typhoid Fever in Taichu City

Year	Population	Incidence	Per 10,000 Population	Deaths	Percent Mortality
1927	45,044	23	5.1	7	30
1928	47,947	33	6.8	10	30
1929	50,750	44	8.6	9	20
1930	54,209	57	10.5	23	40
1931	57,359	37	6.4	10	27
1932	61,857	35	5.6	8	22
1933	64,991	37	5.6	10	27
1934	68,414	73	10.6	16	21
1935	71,742	125	17.4	23	18
1936	74,839	133	17.7	19	14
Average	64,006	59.9	9.4	13.7	24.9

So (1935) reported 51 in-patient cases of infantile typhoid fever in Tainan area from 1933 to 1935.

One hundred thirty two (132) infantile cases of typhoid and eight (8) infantile cases of paratyphoid were admitted to the Takao Hospital within a period of five (5) years from 1930 to 1935 (Kō, 1936). Their distribution according to sex was: typhoid, 54.5 percent male, and 45.5 percent female; paratyphoid, 87.5 percent male, 12.5 percent female.

In Kagi (Kubota, 1940) there were recorded 162 cases of typhoid fever treated in Kagi Hospital from 1937 to 1939. Among these there were 46 deaths, the case fatality being 28.40 percent.

In Karenko District, reported typhoid cases were comparatively few. There were only ten (10) cases from 1931 up to June 1932 (Matsumoto, 1937); there were nine (9) cases occurring in Karenko-Kai in June and 31 in Yoshino village from July to December, 1932. The distance between the two localities is about four (4) kilometers.

In Bōko Islands 81 cases of typhoid fever and seven (7) cases of paratyphoid fever were reported from 1933 to 1937 (Watanabe, 1938). Their annual distribution was as follows:

	1933	1934	1935	1936	1937	Total
Typhoid	9	19	12	23	18	81
Paratyphoid	2	4	1	-	-	7

The distribution of incidence and mortality rate per 10,000 population of typhoid fever in the important cities of Formosa is shown in Table VI.

TABLE VI

Typhoid Fever in Some Formosan Cities (Aschi and Aida, 1937)

Year	Taichu		Taihoku		Tainan		Kiirun		Takao		Kagi		Shinchiku		Shōka		Heito	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
1927	23	5.1	425	19.8	77	8.8	53	7.9	34	6.7	-	-	-	-	8	3.8	31	10.2
1928	33	6.8	565	25.3	89	9.9	139	20.1	46	8.5	60	11.6	-	-	5	2.3	49	15.4
1929	44	8.6	484	20.7	77	8.3	90	12.4	71	12.0	51	9.4	-	-	2	0.9	30	9.0
1930	57	10.5	565	23.1	72	7.7	114	15.2	80	12.3	63	10.8	22	4.6	2	0.8	19	5.4
1931	37	6.4	261	10.1	77	7.7	42	5.3	108	16.1	47	7.3	23	4.7	0	0.	32	8.7
1932	35	5.6	358	13.4	43	4.1	53	6.5	34	4.6	42	6.6	8	1.5	1	0.3	20	5.3
1933	37	5.6	224	8.1	76	7.1	63	7.7	42	5.4	64	9.5	18	3.4	1	0.2	26	6.6
1934	73	10.6	345	12.1	55	5.0	46	5.4	80	9.8	28	3.9	33	6.0	7	1.3	30	7.1
1935	125	17.4	329	11.4	115	10.2	61	6.9	105	12.0	21	2.8	59	11.0	10	1.9	30	6.8
1936	133	17.7	411	14.0	37	3.1	128	14.2	85	9.0	15	1.9	34	6.1	25	4.6	16	3.4

Dysentery. In the official report of the Formosan Government (Taiwan Sotokufuho, 1940-1941) 454 cases of dysentery were listed in Formosa in 1940 and 300 cases and 60 deaths in the first seven months of 1941. The prefectural and seasonal distribution of the disease is here given for a period of a year, May 1940 to April 1941:

TABLE VII

Prefectural Distribution of Dysentery in Formosa
from May 1940 to April 1941

	Taihoku	Shinchiku	Taichu	Tainan	Takao	Taitō	Karenko	Bōko	Total
1940 May	33	4	4		3		1		45
June	37	2	2	3	-	-	-	4	48
July	33	2	1	1	-	-	-	1	38
Aug.	46	-	1	-	4	-	1	1	53
Sept.	41	1	2	1	2	1	1	1	50
Oct.	37	-	1	7	4	-	1	-	50
Nov.	37	-	1	6	10	-	-	1	55
Dec.	17	-	-	3	1	-	1	3	25
1941 Jan.	7	-	2	1	1	-	-	2	13
Feb.	12	1	1	3	4	1	-	-	22
Mar.	12	-	-	11	4	-	1	-	28
Apr.	22	1	-	4	9	1	2	2	41
Total	334	11	15	40	42	3	8	15	468

The incidence of bacillary dysentery in the important cities of Formosa is shown in Table VIII.

According to Shimada (1936) dysentery was rather common among the children in Taihoku. There was an average of about 60 cases every year, being about five (5) percent of the total patients in the Pediatrics Department of Taihoku Hospital. Most of the cases occurred in May and were Japanese of the ages 2-7 years. About 72.5 percent of the cases were bacillary dysentery. Of this 93.9 percent were of the atypical type, 7.3 percent of Ohara type and only 0.3 percent of Shiga type. There were only one-twentieth as many amoebic cases as bacillary cases.

TABLE VIII

Bacillary Dysentery in Formosan Cities (Kojima et al, 1940)

City	Number of Cases						Rate per 10,000 Population					
	1934	1935	1936	1937	1938	Average	1934	1935	1936	1937	1938	Average
Kiirun	50	62	56	107	137	82.4	5.91	7.09	6.24	11.52	14.37	9.16
Taihoku	87	101	87	41	134	90.0	3.07	3.50	2.98	1.35	4.08	3.19
Shinchiku	2	1	-	4	9	3.2	0.37	0.18	-	0.70	1.56	0.58
Taichu	-	1	1	10	12	4.8	-	0.14	0.13	1.30	1.51	0.94
Shōka	4	2	1	?	-	1.8	0.78	0.37	0.18	?	-	0.33
Kagi	9	1	2	15	23	10.0	1.28	0.14	0.26	1.87	2.67	1.29
Tainan	3	1	7	20	-	6.2	0.27	0.08	0.60	0.16	-	0.53
Takao	9	6	14	22	34	17.0	1.10	0.69	1.49	2.17	3.09	1.80
Heito	5	1	-	1	3	2.0	1.20	0.22	-	0.20	0.59	0.43

Note: The data for Kiirun includes only bacillary dysentery, while those of other cities includes part of the amoebic dysentery cases.

In the city of Kiirun there was a marked increase in the reported dysentery cases in recent years, especially bacillary dysentery. This upward trend is clearly shown in Table IX.

The types of the bacillary dysentery and their prevalence in Kiirun are given in Table X.

In Kiirun 35 strains were isolated in September to November 1939 by Kurimoto and 18 strains agreed with Komagome B, one (1) with Nakamura type (Ishiama, 1941). Tomoishi (1933) reported that over 70 cases of dysentery in children were treated in Kagi Hospital from November 1932 to October 1933. It was proven that 34 cases were amoebic dysentery and 30 cases were bacillary dysentery. Of the latter according to Minota's classification the following types were determined:

Type II	59.1%
Type IV	13.6%
Type V	9.1%
Nakamura Type	4.6%
Paradysentery Type A (Ohara-Minota Type)	13.6%

In Pescadores 74 cases of bacillary dysentery and ten (10) cases of amoebic dysentery were reported from 1933 to 1937 with their annual distribution as follows (Watanabe, 1938):

	1933	1934	1935	1936	1937	Total
Bacillary Dysentery	8	23	6	17	20	74
Amoebic Dysentery	3	4	1	-	2	10

TABLE IX

Cases of Dysentery in Kiirun from 1920 to 1938
(Kojima et al, 1940)

Year	Bacillary Dysentery	Amoebic Dysentery
1920	0	10
1921	0	15
1922	0	11
1923	0	3
1924	1	3
1925	0	12
1926	6	10
1927	5	14
1928	11	3
1929	14	5
1930	17	4
1931	42	5
1932	44	3
1933	55(4)	3
1934	50(3)	4
1935	62(4)	4
1936	56(4)	4
1937	107(13)	0
1938	137(33)	2

Note: 1. The data before 1930 were based on Endo's report.
2. The figures in parentheses indicate the cases based on the examination of the dead bodies.

According to Miyagawa and Endo (1933) the mortality rate of dysentery in Taihoku City and Kiirun was 13.3 percent for bacillary dysentery and 4.66 percent for amoebic dysentery.

Sasaki (1937) reported 26 cases of pseudocholera infantum occurring in central Formosa within two years (1935-1936). Twenty-three (23) cases were Japanese and three (3) were Formosans; 18 were boys and eight (8) were girls. Eight (8) cases were reported from Kagi, in 1935.

TABLE X

Bacillary Types and Their Prevalence in Kiirun from January 1935 to the End of 1938 (Kojima et al, 1940)

Types	Number Strains Examined	Number Cases Examined	Percent
Komagome Type B	232	213	52.72
Schmitz Type	40	39	9.65
Kawase Type II	38	38	9.41
Komagome Type AI	31	31	7.67
Komagome Type B2	27	26	6.43
Komagome Type B3	19	18	4.46
Kawase Type III	14	14	3.74
Ohara Type	8	8	1.98
Kawase Type I	4	4	0.99
Komagome Type AII	4	4	0.99
Komagome Type Bx	6	6	1.49
Unknown	3	3	0.74
Total	426	404	

Cholera. There were two cases and one death reported from Takao Prefecture in 1940 (Taiwan Sotokufuho, 1940); the fatal case occurred in February and the other case in March.

Intestinal Protozoan Infections. There has not been much work done on the prevalence of intestinal protozoa in the southern part of Formosa. Kō (1941) made fecal examinations of 1,287 persons who had the habit of eating betel nut in Toko-gun of Takao Prefecture. His results are recorded in Table XI.

Narihara and Chō (1941) examined the feces of 503 students (95 Japanese and 408 Formosans) of Takao Prefectural Tento Agriculture School and found 19.85 percent to be parasitized with protozoa. Of these 10.73 percent were by Endolimax nana which was most common. Endamoeba coli, Endamoeba histolytica, Giardia lamblia and Iodamoeba butschlii were in order the next most common.

TABLE XI

Fecal Examination of Residents of Toko-gun Who Habitually Eat Betel Nut

	No. Examined	Total Positive		Total Negative		Endamoeba histolytica		Endamoeba coli		Iodamoeba		Endolimax nana		Dientamoeba		Trichomonas hominis		Chilomastix mesnili		Giardia lamblia	
		No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent
Male	527	148	28.09	379	71.91	30	56.9	38	7.21	11	2.08	44	8.34	2	0.38	2	0.38	2	0.38	19	3.60
Female	760	284	37.36	476	62.63	49	6.44	63	8.28	13	1.71	88	11.57	8	1.05	11	1.44	8	1.05	34	4.47
Total	1,287	432		855		79		101		24		132		10		13		10		53	

THE ACUTE RESPIRATORY DISEASES AND TUBERCULOSIS

(Chapter VIII)

There were 31,418 deaths of acute respiratory diseases reported in Formosa in 1935; 5,145 were from bronchitis, 22,141 from pneumonia and 1,653 from pleuritis (Tomuku Tokei, 1937).

Pneumonia. According to Oda (1937), in the cities of over 100,000 population in Japan the incidence of pneumonia is 1.33-2.63 per 1,000, while in the seven (7) large cities of Formosa it is 0.61-1.49 for the Japanese and 2.57-5.50 for the Formosans. Chō and Shu (1940) reported that 232 cases of lobar pneumonia were admitted to the Medical College of the Taihoku Imperial University from 1931 to 1938, with the highest number of 57 in 1934 and lowest 12 in 1931. The age distribution and seasonal prevalence of the incidence and deaths are given in Tables XII and XIII.

TABLE XII

The Distribution of the Cases and Deaths of Lobar Pneumonia in Taihoku According to Age

Age	Below 6	6-10	11-20	21-30	31-40	41-50	51-60	61-70	Above 70	Total
Number of Cases	29	16	36	53	38	32	17	9	2	232
Percent of Total Cases	12.5	6.9	15.5	22.8	16.4	13.8	7.3	3.9	0.9	
Number of Deaths	9	2	6	10	8	7	6	3	2	53
Case Fatality Rate	31.0	12.5	16.7	18.9	21.1	21.9	35.3	33.3	100.0	22.8

Rin (1936) reported that in a period of five (5) years from January 1931 to December 1935 there were 432 cases of infantile pneumonia in Takao Prefecture. Of these cases 133 were lobar pneumonia, 226 were catarrhal pneumonia, 21 were pneumonia of unknown type, 37 were pleuropneumonia and five (5) cases were accompanied by typhoid fever. Lobar pneumonia had its highest incidence in March, next highest in April and May and lowest in August and September. Catarrhal pneumonia was most common in June, May and July and least common in October, November, and December according to the order listed. The mortality rate of lobar pneumonia was 15 percent and that of catarrhal pneumonia was 24.5 percent.

TABLE XIII

The Seasonal Distribution of the Cases and Deaths of Lobar Pneumonia in Taihoku

Cases	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
No. of Cases	25	32	42	31	22	23	5	9	9	8	12	14	232
Percent of Total Cases	10.8	13.8	18.1	13.4	9.5	9.9	2.1	3.9	3.9	3.5	5.2	6.0	
No. of Deaths	1	9	7	9	3	5	2	5	1	5	3	3	53
Case Fatality Rate	4.0	28.1	16.7	29.0	13.6	21.7	40.0	55.6	11.1	62.5	25.0	21.4	22.8

Tuberculosis. There were 8,416 deaths from tuberculosis in Formosa in 1935 (Tomuku Tokei, 1937). The Government-General of Formosa reported (Taiwan Jijo, 1939) that the annual number of tuberculosis cases reaches about 80,000-90,000 with over 8,000 deaths. The facilities for the tuberculosis patients are the Taiwan Government Matsuyama Clinic (capacity 150 in 1939), tuberculosis ward of the Formosa Red Cross Branch Hospital, and the isolated wards of other hospitals. In 1939 it had been planned to establish a prefectural tuberculosis clinic in Taihoku prefecture and another in Tainan prefecture.

According to Soda (1934) the death rate of tuberculosis in Formosa, as compared with that in Japan, was lower among the young but much higher among the old people, and in Formosa the death rate was higher among the old in the southern part than in the northern part. The reason for this is not known.

Oda et al (1936) made studies on the tuberculin reaction of the inhabitants of Formosa and the results may be summarized as follows: The positive reactions to tuberculin among the public school children in Formosa is about 30-40 percent (as in Kiirun, Taihoku, Taichu, Kagi, and Tainan). Three hundred and eight (308) of the college students were tested with a positive rate as follows: 70.3 percent among the Japanese and 78.9 percent among the Formosans. Of the 328 factory workers tested 89.1 percent of the Japanese and 96.0 percent of the Formosans showed a positive reaction. Among the 732 middle school children the positive rate increased from 38.0 percent to 50.7 percent for the Japanese and from 48.4 percent to 65.6 percent for the Formosans within a period of one and a half years. In Tainan Prison 1,143 persons were tested and 93.97 percent had positive reaction to tuberculin. The authors also reported that from November 1934 to October 1936 there were 447 Japanese and 266 Formosan cases treated in the Department of Internal Medicine, Taihoku Hospital; these groups making up 6.8 percent and 6.2 percent of the total out-patients respectively.

ACUTE INFECTIOUS DISEASES

(Chapter IX)

Diphtheria. The official report of the Government-General of Formosa (Taiwan Sotokufuho, 1940-1941) shows that there were 1,394 cases of diphtheria in 1940; 847 cases and 130 deaths through July in 1941. The seasonal and prefectural distribution of the disease for the year, May 1940 to April 1941, is given in Table XIV.

TABLE XIV

Prefectural Distribution of the Cases of Diphtheria from May 1940 to April 1941 in Formosa

		Taihoku	Shinchiku	Taichu	Tainan	Takao	Taitō	Karenko	Bōko	Total
1940	May	16	6	8	15	15	1	1	-	62
	June	13	4	23	14	10	3	3	-	70
	July	23	5	16	23	15	3	8	1	94
	Aug.	70	13	15	8	10	-	5	1	122
	Sep.	58	29	21	32	8	-	4	3	155
	Oct.	60	29	28	26	12	1	4	2	162
	Nov.	82	38	30	20	18	2	5	3	198
	Dec.	62	30	25	31	32	1	11	1	193
1941	Jan.	70	23	26	22	25	2	4	1	173
	Feb.	27	18	14	24	26	1	2	-	112
	Mar.	39	7	8	19	14	2	5	1	95
	Apr.	18	2	11	30	23	3	5	-	92
Total		538	204	225	264	208	19	57	13	1528

Asahi and Aida (1938) in their epidemiological observations of diphtheria epidemics in Taichu City, give the figures of the incidence and deaths of this disease in the principal cities of Formosa for a period of five (5) years (Table XV).

TABLE XV

Incidence and Deaths of Diphtheria in the Principal Cities of Formosa (1932-1936)

Place		1932	1933	1934	1935	1936
Taichu	Cases	41	45	58	51	53
	Deaths	2	1	3	0	3
	Case Fatality	4.8	2.2	5.1	-	5.6
Taihoku	Cases	244	206	297	253	311
	Deaths	33	12	29	30	39
	Case Fatality	13.5	5.8	9.7	11.9	12.5
Tainan	Cases	30	29	49	64	43
	Deaths	1	3	5	4	2
	Case Fatality	3.3	10.3	11.1	6.2	4.6
Kiirun	Cases	26	40	23	20	31
	Deaths	2	3	2	2	3
	Case Fatality	7.6	7.5	8.6	10.0	6.4
Takao	Cases	5	7	13	7	23
	Deaths	0	4	2	3	3
	Case Fatality	-	57.1	15.3	42.8	13.6
Kagi	Cases	4	10	4	16	6
	Deaths	1	1	2	2	0
	Case Fatality	25.0	10.0	50.0	12.5	-
Shinchiku	Cases	20	46	56	22	20
	Deaths	4	5	8	3	2
	Case Fatality	20.0	10.8	14.2	13.6	10.0
Shōka	Cases	2	2	6	4	2
	Deaths	0	1	0	0	0
	Case Fatality	-	50.0	-	-	-
Heito	Cases	6	8	6	14	14
	Deaths	1	0	5	3	3
	Case Fatality	16.6	-	83.3	21.4	21.4

Cerebrospinal Meningitis. Epidemic cerebrospinal meningitis was introduced to the southern coastal region of Formosa in 1903-1904. It has occurred sporadically in different places since that time. In 1934 there were 155 cases in northern Formosa and in 1939 there were 342 cases in Tainan Prefecture. In Taiwan Sotokufuho (1940-1941) 634 cases of epidemic cerebrospinal meningitis were reported in 1940 in Formosa and 210 cases and 77 deaths in the first seven (7) months of 1941. The prefectural distribution from May 1940 through April 1941 is given in Table XVI.

TABLE XVI

Prefectural Distribution of Cerebrospinal Meningitis in Formosa from May 1940 through April 1941

		Taihoku	Shinchiku	Taichu	Tainan	Takao	Taitō	Karenko	Bōko	Total
1940	May	6	1	4	7	10	7	2	-	37
	June	2	-	2	2	2	1	2	1	12
	July	2	-	1	5	3	3	-	-	14
	Aug.	2	-	1	3	6	-	-	-	12
	Sep.	2	-	1	3	4	1	1	-	12
	Oct.	2	-	-	2	3	1	1	-	9
	Nov.	2	-	-	-	1	4	-	-	7
	Dec.	2	1	1	4	3	3	5	-	17
1941	Jan.	3	1	3	3	26	7	4	-	47
	Feb.	8	-	4	3	27	22	5	-	69
	Mar.	3	-	1	4	9	12	4		33
	Apr.	4	1	4	2	7	1	2	-	22
Total		38	4	22	38	101	62	26	1	291

Noda and Sugita (1941) made an epidemiological investigation of the disease in Formosa, based on the records of 20 years from 1919 to 1938. They found that both morbidity and mortality of the disease are higher in Formosa than in Japan. In Japan the number of cases per 100,000 population in the same period was 1.23 while in Formosa it was 3.57, nearly three times as high. The mortality rate was 56.95 percent in Japan and it was 60.52 percent in Formosa.

The distribution of the disease (cases per 100,000 population) in the different prefectures of Formosa was as follows:

Taitō-cho	28.99	Taichu-shu	2.78
Tainan-shu	4.89	Takao-shu	2.52
Karenko-cho	9.97	Shinchiku-shu	1.57
Taihoku-shu	3.70	Bōko-cho	0.50

The rate per 100,000 for urban districts was 3.52 and that for rural districts was 3.68. The seasonal distribution of the disease in Formosa may be shown in the following order of frequency: March (34.54 percent), April (18.20 percent), February (14.15 percent), January (7.14 percent), December (5.67 percent), May (5.64 percent), June, November, July, August, September and October. According to Kiribayashi et al (1941) there were 156 cases in Taichu Prefecture in a period of 14 years from 1926 to 1939, 61 cases in 1935, 20 cases in 1936 and 30 cases in 1939.

There were 211 cases, 210 Formosans and one (1) male Japanese, which occurred in one outbreak in Taichu Prefecture during March and April 1940. This epidemic is summarized in Tables XVII and XVIII.

TABLE XVII

Cases of Cerebrospinal Meningitis According to Counties in Taichu Prefecture, 1940

Region	County	Jan	Feb	Mar	Apr	May	Total	Percent
	Taiko-gun	-	-	16	10	2	28	13.27
Coastal	Shoko-gun	-	19	33	2	-	54	25.59
	Hokuto-gun	2		-	1	-	3	1.42
	Hogen	2	1	7	6	1	17	8.05
	Taiton	-	-	13	-	-	13	6.16
Central	Taichu-shi	-	-	4	-	-	4	1.90
	Shōka-shi	-	-	1	-	-	1	0.47
	Winrin-gun	-	-	31	7	-	38	18.01
	Tosei-gun	-	-	-	1	-	1	0.47
	Nanto-gun	-	-	10	1	-	11	5.21
Hilly	Noko-gun	-	1	2	1	-	4	1.90
	Shinko-gun	-	-	2	2	-	4	1.90
	Chikusan-gun	-	-	31	2	-	33	15.63
	Total	4	21	150	33	3	211	
	Percent	1.89	9.55	71.09	15.63	1.42		

TABLE XVIII

Cerebrospinal Meningitis, Case Fatality in Taichu Prefecture, 1940

Region	Recovered		Deaths		Total	
	Number	Percent	Number	Percent	Number	Percent
Coastal	51	(60.00)	34	(40.00)	85	(40.28)
Central	34	(46.58)	39	(53.42)	73	(84.59)
Hilly	28	(25.83)	25	(47.17)	53	(25.11)
Total	113	(53.55)	98	(46.45)	211	(100)

Yuge (1937) reported that tuberculous meningitis composes 50 percent of the other meningitides among the children in Formosa.

Epidemic Encephalitis. Twenty-five (25) cases of epidemic encephalitis were officially reported (Taiwan Sotokufuho, 1940-1941) in 1940 in Formosa, and 30 cases with seven (7) deaths January through July, 1941. All the cases except one (1) occurred in the period June to October. The exceptional case occurred in January in Taichu Prefecture. The disease is most prevalent in Taihoku Prefecture. The following is the prefectural distribution of the 55 cases:

Taihoku	39
Shinchiku	6
Taichu	7
Tainan	1
Takao	2
Taitō	0
Karenko	0
Bōko	0
Total	55

Kobayashi (1939) reported that in the epidemic area of Okayama Prefecture of Japan as high as 2.05 percent of Culex pipiens pallens and C. tritaeniorhynchus carried the virus of the disease. However, there is no information regarding the transmission of this disease in Formosa.

Smallpox. There was an explosive outbreak of smallpox in Tainan Prefecture in the spring of 1939 (Noda et al, 1939). There were 67 cases occurring from March 14 to April 15, 62 of the cases were in Jo-sansho, Shinka-gun. The locality of the other five (5) was not known. All the cases were Formosans, 34 males and 33 females. The virus was found to be introduced from the opposite coast. From January 1940 to July 1941 only three (3) cases of smallpox were officially reported in Formosa (Taiwan Sotokufuho, 1940-1941), two (2) cases from Taichu Prefecture, and one from Tainan Prefecture, occurring in May 1940.

Data on smallpox vaccination in Formosa from 1934 to 1938 are shown in Table XIX.

TABLE XIX

Smallpox Vaccination in Formosa, 1934-1938 (Taiwan Jijo, 1939)

Year	Periodical Vaccination 1st Time Positive	1st Time Negative	2nd Time Positive	2nd Time Negative	Temporary Vaccination Positive	Temporary Vaccination Negative	Total Positive	Total Negative	Total	Percent Positive	Percent Negative
1934	190450	15408	68136	88998	11112	43353	269698	147759	417457	64.60	35.40
1935	203150	10456	88311	77868	628	-	292089	88324	380413	76.78	23.22
1936	204708	8518	96783	65169	46	29	301537	73716	375253	80.36	19.64
1937	206080	10965	101086	58277	829	3563	307995	72805	380800	80.88	19.12
1938	210885	13188	107341	56275	4445	2484	322671	71947	394618	81.77	18.23

Scarlet Fever. There were 61 cases of scarlet fever in Formosa in 1940 and 21 cases in 1941 through July according to the Formosan official report (Taiwan Sotokufuho, 1940-1941). The following table will illustrate its prefectural distribution in one (1) year.

TABLE XX

Prefectural Distribution of the Scarlet Fever Cases in Formosa (May 1940-April 1941)

		Taihoku	Shinchiku	Taichu	Tainan	Takao	Taitō	Karenko	Bōko	Total
1940	May	3	-	-	-	1	-	-	-	4
	June	5	-	-	1	-	-	-	-	6
	July	3	-	-	-	-	-	-	-	3
	Aug.	2	-	-	1	-	-	-	-	3
	Sep.	1	-	-	-	-	-	-	-	1
	Oct.	7	-	-	1	-	-	-	-	8
	Nov.	6	-	-	2	1	-	-	-	9
	Dec.	5	-	-	1	-	1	-	-	7
1941	Jan.	7	-	-	-	-	-	-	-	7
	Feb.	4	-	-	-	-	-	-	-	4
	Mar.	-	-	2	1	-	-	-	-	3
	Apr.	1	-	-	1	-	-	-	-	2
Total		44	-	2	8	2	1	-	-	57

Measles. Cho (1937) reported an epidemic of measles in Taihoku from the end of 1935 to the summer of 1936. One hundred and forty one (141) cases (13.9 percent of the total in-patients) were admitted to the Taihoku Hospital. Two-thirds of the cases occurred in March, April and May.

Two (2) cases of exanthema subitum (somewhat similar to rubella) were reported in 1931, three (3) cases in 1933 in Taichu Hospital, and one (1) case was reported in 1934 in Kagi Hospital (Hirotsu, 1937). Twenty-four (24) cases were reported in Taihoku Hospital during a period of three (3) years ending with 1937. This number consists of about 0.021 percent of the total number of child patients which was 11,527

Whooping Cough. There were 1,144 deaths of whooping cough and influenza in Formosa in 1935 as reported in Tomuku Tokei (1937), but no indication was given as to the number of cases for each disease. In the Pediatrics Department of Taihoku Hospital 520 in-patient cases and 1,886 out-patient cases of whooping cough were treated in 1930-1935. One hundred and fifty-four deaths among the in-patients were reported with a mortality rate of 22.5 percent among the Japanese and 35.9 percent among the Formosans. This disease is most prevalent in summer and least prevalent in Autumn.

Tetanus. Tetanus is quite common in Formosa. The incidence rate among the infants in Formosa is about 30 times as high as that in Japan but the incidence rate among the Japanese infants in Formosa is much lower, being about the same as that on Japan mainland. Tables XXI and XXII are from Nabuhara (1938-1939).

TABLE XXI

Incidence of Infantile Tetanus in Formosa, 1932-1936

	1932		1933		1934		1935		1936	
	Cases	Incidence (Rate per 1,000 live births)	Cases	Incidence (Rate per 1,000 live births)	Cases	Incidence (Rate per 1,000 live births)	Cases	Incidence (Rate per 1,000 live births)	Cases	Incidence (Rate per 1,000 live births)
Japanese	6	.77	5	.63	6	.77	6	..75	10	1.26
Formosan	4851	23.67	4843	22.89	4947	22.57	4987	22.07	4924	21.96

TABLE XXII

Infantile Tetanus in Formosa in 1936 According to Prefectures

	Incidence	Incidence Rate per 1,000 Births
Taihoku	640	17.74
Shinchiku	711	24.01
Taichu	1254	22.78
Tainan	1424	22.81
Takao	759	23.52
Taitō	16	6.76
Karenko	61	17.02
Bōko	59	23.03
Total	4924	21.99

OTHER INFECTIOUS DISEASES

(Chapter X)

Leprosy. As it was stated in the manual, leprosy is quite prevalent in Formosa. Its greatest incidence seems to be in the coastal regions. Tables XXIII and XXIV show the incidence of the disease in July 1930 and November 1934 according to the Police Bureau of Formosa (Kamikawa et al, 1936):

TABLE XXIII

Cases of Leprosy According to Prefectures

Prefecture	July 1930	November 1934
Taihoku	456	148
Shinchiku	55	35
Taichu	81	36
Tainan	303	188
Takao	103	91
Taitō	19	7
Karenko	13	7
Bōko	54	65
Total	1,084	577

TABLE XXIV

Cases of Leprosy According to Counties in Taihoku Prefecture

County	July 1930	November 1934
Taihoku-shi	36	52
Shinjō-gun	19	26
Kaisan-gun	1	2
Tansui-gun	5	6
Shichisei-gun	16	15
Kiirun-gun	16	14
Bunson-gun	1	4
Giran-gun	13	8
Ratō-gun	18	18
Suo-gun	7	3
Total	132	148

Kamikawa and Rai (1937) made examinations for leprosy in four localities of two prefectures on the western coast of Formosa; viz., Takao and Tainan. Their results are given in Table XXV.

TABLE XXV

Leprosy in Takao and Tainan

	Place	Number Examined	Number Positive	Percent Positive
Takao	Shajōshō	2,513	19	0.67
	Kikō	11,534	27	0.23
	Total	14,047	46	0.33
Tainan	Sanjōshō	6,365	13	0.20
	Tainan Anhei	5,539	3	0.05
	Total	11,904	16	0.13
	Grand total	25,951	62	0.24

A government leprosy clinic was established in 1930. This clinic had a capacity of 700 in 1939. A private leprosy clinic was established by an English physician in Tansui-gun (at Yarisho) Taihoku Prefecture with a capacity of 80.

Yaws. According to Takahashi, Asai and Chin (1940) the incidence of yaws has shown a distinct decrease in recent years in Taitō District but a moderate increase in Takao Prefecture. Table XXVI gives the cases of both regions for a period of five (5) years (1935-1939).

TABLE XXVI

Incidence of Yaws in Takao Prefecture and Taitō District in 1935-1939*

Locality	1935	1936	1937	1938	1939	Total
Airyōnankei	86	64	64	82	44	340
Airyohokukei	11	11	9	9	0	40
Raishakei	150	166	200	150	230	896
Karusukei	16	12	4	4	0	36
Subonkei	71	31	18	39	20	179
Tokokei	25	25	24	25	25	124
Kokokei (Kōshun-gun)	-	0	0	2	7	9
Total	359	309	319	311	326	1624
Taimarikei	30	0	7	4	6	47
Kanaronkei	3	3	3	4	16	29
Taichikukokei	2	1	2	0	0	5
Coast and along Shōkei	22	31	35	35	38	161
Total	57	35	47	43	60	242

*According to the Divisions of Aboriginal Affairs of both local governments.

Venereal Diseases. In Taiwan Jijo, compiled by the Government-General of Formosa, 1939, the result of examinations of prostitutes for venereal disease was given as follows:

Prostitutes	Number Examined	Syphilis	Chancroid	Gonorrhea	Percent
Licensed	45,582	103	613	1,228	4.26
Unlicensed	1,042	47	51	231	31.57

Ri et al (1941) reported that 53,291 patients were treated in the Department of Skin and Venereal Diseases, Medical College, Taihoku Imperial University, from January 1921 to October 1940. Forty thousand six hundred (40,600) cases (76.185 percent) were skin diseases, 12,691 cases (23.815 percent) were venereal diseases and 1,786 cases were diseases of urinary organs. The following table shows the percentage of the different venereal diseases compared with that in Japan Proper (according to Ito).

TABLE XXVII

Ratio of Various Venereal Diseases

	Number Cases	Percent	Percent in Japan
Syphilis	6,122	48.2	35.5
Gonorrhea	4,771	37.6	55.5
Chancroid	1,143	9.0	9.0
Lymphogranuloma venereum	655	5.2	0.0

TABLE XXVIII

General Incidence of Syphilis in Formosa (Nakagawa et al, 1938)

Place	Persons Examined	Number Examined	Percent Positive
Bacteriological Lab., Taihoku Hospital	Japanese	4,693	22.88
Bacteriological Lab., Taihoku Hospital	Formosan	5,307	33.39
Sanitary Div. of Central Research Bureau	Japanese	5,054	17.51
Sanitary Div. of Central Research Bureau	Formosan	2,531	26.27
Prostitutes in Taihoku	Japanese	446	41.47
Prostitutes in Taihoku	Formosan	208	67.30
Out-patients of skin diseases in Taihoku Red Cross Hospital		44,650	11.14
In-patients of same Hospital	Japanese	142	6.5
In-patients of same Hospital	Formosan	190	8.6

Examinations for syphilis were also made by Nakagawa et al (1938) among the prisoners and the jinrikisha men in Formosa (Table XXIX).

TABLE XXIX

Results of the Examinations of Prisoners

Prisoners	Formosan		Chinese		Japanese	
	Male	Female	Male	Female	Male	Female
No. examined	1699	76	96	1	136	1
No. positive	458	28	23	0	34	0
Percent positive	26.9	36.8	23.9	-	25.0	-
Average percent positive	27.3		23.7		24.8	

Results of the Examinations of Jinrikisha Men

Jinrikisha Men	Number Examined	Number Positive	Percent Positive
Formosan	544	65	11.94
Chinese	720	58	8.05

Watanabe (1937) made examinations for gonococcus in licensed prostitutes in Taihoku City and recorded the data in Table XXX.

TABLE XXX

Examinations for Gonococcus in Licensed Prostitutes in Taihoku City

Place	Number Examined	Positive in Urethra Number	Positive in Urethra Percent	Positive in Cervical Canal Number	Positive in Cervical Canal Percent	Positive in Urethra and Cervical Canal Number	Positive in Urethra and Cervical Canal Percent	Positive in Urethra or Cervical Canal Number	Positive in Urethra or Cervical Canal Percent	Negative Number	Negative Percent
Formosan	125	49	39.2	15	12.0	49	39.2	49	39.2	76	60.7
Korean	48	12	25.0	8	16.6	5	10.4	15	31.2	33	68.7
Japanese	148	43	29.0	17	11.4	8	5.4	52	35.1	96	64.8
Total	321	104	32.3	40	12.4	62	19.3	116	36.1	205	63.8

HELMINTHIASES

(Chapter XI)

Feces of 1,287 persons with betel nut eating habits from Toko-gun of Takao Prefecture were examined by Kō (1941) (Table XXXI).

TABLE XXXI

Fecal Examination of Persons Habitually Eating Betel Nut

	Examined	Total Positive		Total Negative		Ascaris lumbricoides		Trichocephalus trichiurus		Hookworm		Enterobius vermicularis		Trichostrongylus orientalis		Metagonimus yokogawai		Clonorchis sinensis		Fasciolopsis buski	
		No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent
Male	527	506	96.01	21	3.99	506	96.01	493	93.72	322	61.10	9	1.70	0	0	7	1.32	3	0.58	1	0.18
Female	760	742	97.63	18	2.37	742	97.63	676	88.94	450	59.21	24	3.15	1	0.13	8	1.05	1	0.1	0	0.0
Total	1,287	1,248	96.96	39	3.04	1,248	96.96	1,129	87.72	772	59.98	33	2.55	1	0.07	15	1.16	4	0.31	1	0.07

Narihara and Chō (1941) reported that by fecal examination of 503 students in Takao Prefectural Tento Agriculture School, 60.5 percent were found to harbor helminth parasites. Over one half of these were carriers of roundworm and 14.31 percent were carriers of hookworm. One person harbored Clonorchis sinensis and one harbored Metagonimus yokogawai.

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APPENDIX

POISONOUS PLANTS

Uchida and Norikane (1936) reported Laportea pterostidua Wedd., an indigenous plant of Formosa, as causing a peculiar dermatitis in Formosa. The plant belongs to the Family Urticacea and is known only from Formosa. It is a wild plant, commonly found along streams and at the foot of mountains in the southern part of the island and also in the mountains in Karenko District. Besides this species there are two other wild species of Laportea: L. subglabra Hay in Koshun region and L. kotoensis Hay in Botel Tobago.

The leaves of this plant are covered with stinging hairs. The poisonous substance in the hairs, according to the authors is formic acid. The dermatitis caused by this plant is due to the mechanical irritation and chemical content of these hairs. The cutaneous inflammation is of a serous nature and is accompanied by infiltration, swelling, itching and pain. In severe cases vesicles may be formed. The chief characteristic of this inflammation is the peculiar pain which is likened to prickling with needles. The progress of the inflammation varies with different cases. In mild cases it lasts two to four days but in severe cases a longer period will be required for recovery.

Ito (1923) reported the following poisonous plants from Formosa:

1. Solanum nigrum L.
2. Solanum lyratum Thumb
3. Capsicum anomalum Fr. & Sav.
4. Datura alba Nees
5. Ipomaea palmata Forst
6. Nerium odorum Soland
7. Thevetia neriifolia Juss
8. Cerbera odollam Gaertn.
9. Buddleia asiatica Lour.
10. Plumbago zeylanica L.
11. Pieris taivanensis Hay
12. Schima noronhae Reinw.
13. Semicarpus vernicifera Hay & Kawa
14. Coriaria intermedia Matsum.
15. Coriaria summicola Hay
16. Mallotus philippinensis Muell. Arg.
17. Croton tiglium L.
18. Euphorbia tirucalli L.
19. Euphorbia neriifolia L.
20. Zanthoxylum pirtaciiflorum Hay
21. Abrus precatorius L.
22. Millettia pachycaroa Benth
23. Canavelia obtusifolia De.
24. Illicium anisatum L.
25. Ranunculus japonicus Langsd.
26. Ranunculus acris L.
27. Phytolacca acinosa Roxb.
28. Urtica thunbergiana S. et. Z.
29. Laportea pterostigma Wedd.

30. Dianella nemorosa Lam.
31. Veratrum nigrum L. var. japonica Bak.
32. Alocasia macrorrhiza Schott.
33. Arisaema ringens Schott.
34. Zantedetchia aethiopica Spr.